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ABSTRACT

This guide, designed for fourth- through sixth-grade classrooms, contains information teachers will need to teach an educational unit on indoor air quality. It draws on a variety of students' skills, including science, vocabulary, reasoning, math, and basic biology. Each lesson comes with suggested activities that highlight and reinforce what is being taught in that section. Each section can be made into overheads or handouts for the students to use. Sections introduce the common indoor air pollutants and words associated with indoor air pollution; address the major air pollutants, their sources, and their health effects; highlights potential sources of pollution and recommends solutions to help prevent air quality problems; discusses how pollutants affect the human body; examines how and why pollutants get int the air and the importance of detecting and fixing those sources; and explores the importance of good indoor air quality in schools and classrooms and what teachers and students can do to improve air quality in their classrooms. (GR)

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Teacher's Guide to Indoor Air Pollutants

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National Safety Council

Available at:
http://www.nsc.org/ehc/indoor/teachers.htm

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Teacher's Guide to Indoor Air Pollutants

Developed by
The National Safety Council's
Environmental Health Center
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http://www.nsc.org/ehc.htm

National Safety Council

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Dear Teacher:

The National Safety Council's Environmental Health Center (NSC's EHC) and the U.S. Environmental Protection Agency (EPA) would like to thank you for taking the time to use this guide to reach out to your students and teach them the importance of indoor air quality (IAQ).

This guide has been developed in cooperation with EPA's *Indoor Air Quality Tools for Schools Action Kit*. If your school is currently using *IAQ Tools for Schools*, this guide is an excellent companion tool. For those who don't know about this easy-to-use "Kit," it shows school administrators and other school personnel how to help ensure that your school's environment is healthy by doing simple activities to reduce the possibility of serious indoor air quality problems. You do not have to use *IAQ Tools for Schools Kit* to benefit from this guide. However, if you would like to order a *IAQ Tools for Schools Kit*, please refer to the Indoor Air Quality Information Clearinghouse in the "Supporting Materials" at the back of the guide.

Good and Bad News for Everyone!

The bad news about indoor air is that it often contains higher concentrations of hazardous pollutants than outdoor air. The good news is that everyone can reduce indoor air pollution.

How can the air inside our homes be so bad for us? Over the years, buildings have been made more airtight to conserve energy. A variety of methods have been used to keep the hot/cool air from escaping our homes: installing storm windows, adding insulation, and applying caulking and weatherstripping to seal cracks and other openings. Unfortunately, when we trap in hot or cool air, we also trap in pollutants and sometimes generate more. EPA studies have found that pollutant levels inside can be two to five times higher than outdoors. After some activities, indoor air pollution levels can be 100 times higher than outdoors.

On average, people spend about 90 percent of their time indoors. Sixty-five percent of that time is spent at home. To make matters worse, those who are most susceptible to indoor air pollution are the ones who are home the most: infants, children, pregnant women, the elderly, and those with chronic illnesses. In addition, children breathe in 50 percent more air per pound of body weight than adults do.

How do you know if the air inside your home is dangerous to your health? Many indoor air pollutants cannot be detected by our senses. The symptoms they produce can be vague and sometimes similar, making it hard to attribute the symptoms to a specific cause. Some symptoms may not show up until years later, making it even harder to discover the cause. Common symptoms of exposure to indoor air pollutants include headaches, tiredness, dizziness, nausea, itchy nose, and scratchy throat. These symptoms may be mistaken for flu symptoms. More serious effects are asthma, other breathing disorders, and cancer.

Sources of pollutants can be found throughout the home and include cleaning products, paints, fertilizers, and pesticides. Less obvious pollutants are caused by such simple tasks as cooking, bathing, or heating the home. Fortunately, everyone can take some easy steps to reduce the potential for indoor air pollution and improve the quality of the air they breathe.

EHC believes that if young people are informed about the hazards of indoor air pollution and ways to avoid or correct problems, they can help reduce environmental health risks for themselves and their families. Students should be encouraged to bring home to their parents what they learned in the classroom. EHC has developed this guide for teachers to help students understand the importance of clean air and what they can do to help clean the air they breathe.

If you would like additional information on indoor air quality or need to speak to an environmental health specialist, please call the EHC's Air Quality Program Helpline at (800) 557-2366.

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Introduction

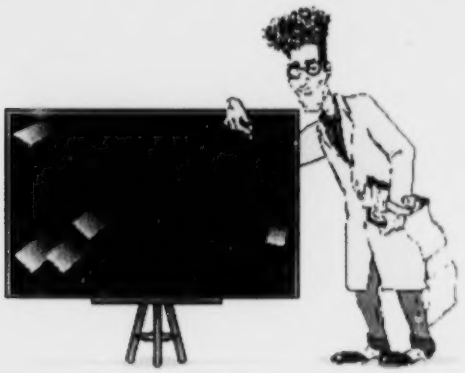
This guide and the activities in it are designed to be used in 4th through 6th grade classrooms. These tools are designed to help students increase their knowledge of indoor air quality (IAQ) problems and solutions. The lesson plans can easily be incorporated into the general science or health sections of your curriculum. The activities include various games, surveys, questionnaires, and simple experiments. Students will use skills in a variety of areas: science, vocabulary, math, and basic biology. Most of the activities can be completed in one class period. However, some require two periods, or parts of several class periods over several days. Some of the activities are designed to be completed by the students at home with the help of an adult. EHC encourages all teachers to stress to their students the importance of sharing this information at home.

This guide is meant to be easy to use and adapt. While we recommend using all of the lesson plans, each one can be used by itself or combined with others. Following the sequence of the plans is recommended, but the order or content may be modified to fit specific classroom needs. You may want to develop additional activities to help your students learn about IAQ. If there is any activity that you find worked particularly well (ours or yours), please let us know. EHC is always looking for ways to improve this guide.

Major Program Objectives

After completing the indoor air quality lesson plans and activities the students will be able to the following:

- ✓ Identify people's perceptions about and knowledge of indoor air quality
- ✓ Identify sources of indoor air pollution
- ✓ Describe the range of characteristics of indoor air pollution
- ✓ Identify ways of detecting and correcting indoor air pollution problems
- ✓ Describe the health risks from exposure to indoor air pollutants
- ✓ Identify potential indoor air quality hazards in the home and classroom
- ✓ Use problem solving skills to determine a course of action to reduce indoor air quality problems



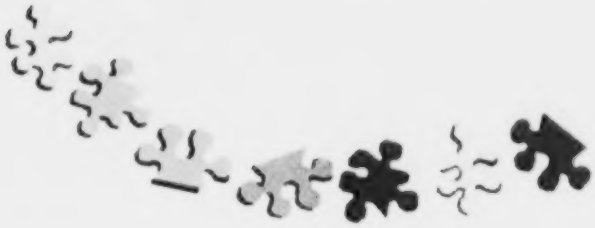
Preparation

This section provides guidelines for teachers to help them prepare to teach the IAQ unit.

The following is a list of things teachers should do before teaching this unit:

- Read through the entire guide, including activities. If you have questions or need assistance, call EHC's Helpline at (800) 557-2366.
- Read all of the supporting materials included with the guide. They describe the various indoor air pollutants, their sources and health effects, and other IAQ information you will need when teaching your class.
- Modify activities to meet the needs of your class, if necessary.
- Make a list of all of the materials you will need.
- Make any handouts and overheads that you will need.

You may want to summarize the information in the fact sheets. Try using 10 to 15 key points from each fact sheet to develop an information packet for the students.



Preliminary Knowledge & Follow-up

This section helps the teacher determine how much students already know or have learned about indoor air quality.

Suggested Activity:
Indoor Air Quality True or False Worksheet

Purpose:
To determine how much the students know about indoor air quality

Objective:
The teacher will evaluate how much the students need to learn about indoor air quality.

Time Needed:
Approximately 45 to 50 minutes.
Allow ample discussion time, keeping in mind many of the questions will be answered as you work through the unit.

Skill Building:
Time management

Materials:
True or False handouts or chalkboard and chalk

What To Do:

Before Class:

1. Hand out the student worksheet or write the questions on the chalkboard.
2. Review fact sheets on indoor air pollutants.

When Class Begins:

1. Split the class into groups of two to five students. Give each student a worksheet (or a blank piece of paper). Have each student write down their answers and have one member of each group be responsible for tabulating the group's answers. That person should be given an extra worksheet to record the group's answers.
2. Discourage students from guessing at the answers. They should have a good explanation for why they picked each answer.
3. When the groups have finished, go around the room to find out each group's answers and why they picked them. Continue until all questions have been answered. Use the answer sheet for the correct answers.
4. Discuss the answers.

Indoor Air Quality
True or False Worksheet

Check True or False for each question

1. The air inside our homes is always safe. ❑ True ❑ False
2. Indoor air pollution may be more hazardous to your health than outdoor air pollution. ❑ True ❑ False
3. You can't see, smell, or taste many indoor air pollutants. ❑ True ❑ False
4. Indoor air pollutants can make you sick right away or not for weeks, months, or years. ❑ True ❑ False
5. Lead hurts young children and pregnant women more than other people. ❑ True ❑ False
6. Pets are a source of pollution (for example, dander). ❑ True ❑ False
7. You can't do anything to prevent indoor air quality problems. ❑ True ❑ False
8. Indoor air pollutants can be either natural or artificial. ❑ True ❑ False
9. Spending more time outdoors will always relieve the symptoms of an indoor air quality problem. ❑ True ❑ False
10. It is very easy to tell if someone is sick because of bad indoor air. ❑ True ❑ False
11. People typically spend an average of 90 percent of their time indoors. ❑ True ❑ False
12. Radon smells like rotten eggs. ❑ True ❑ False
13. All indoor air pollutants are artificial. ❑ True ❑ False
14. Carbon monoxide comes from burning fuels. ❑ True ❑ False
15. Carbon monoxide is an odorless, colorless gas that causes serious health problems. ❑ True ❑ False
16. Formaldehyde is a gas that can come from building materials and furnishings. ❑ True ❑ False
17. Opening a window will always solve an indoor air pollution problem. ❑ True ❑ False
18. Secondhand cigarette smoke can cause cancer. ❑ True ❑ False
19. Pesticides only hurt the pests they were designed to kill. ❑ True ❑ False
20. Carbon monoxide comes from electricity. ❑ True ❑ False
21. Smoking is only dangerous to the person who is smoking. ❑ True ❑ False
22. Radon can cause lung cancer. ❑ True ❑ False
23. Every home, no matter what size or shape or where it is located, should be tested for radon. ❑ True ❑ False
24. Health problems caused by indoor air pollution are always felt right away. ❑ True ❑ False
25. Radon is found in household cleaners. ❑ True ❑ False

Indoor Air Quality
True or False Answer Sheet

Check True or False for each question

1. The air inside our homes is always safe.	❑ True	☑ False
2. Indoor air pollution may be more hazardous to your health than outdoor air pollution.	☑ True	❑ False
3. You can't see, smell, or taste many indoor air pollutants	☑ True	❑ False
4. Indoor air pollutants can make you sick right away, or not for weeks, months, or years.	☑ True	❑ False
5. Lead hurts young children and pregnant women more than other people.	☑ True	❑ False
6. Pets are a source of pollution (for example, dander).	☑ True	❑ False
7. You can't do anything to prevent indoor air quality problems.	❑ True	☑ False
8. Indoor air pollutants can be either natural or artificial.	☑ True	❑ False
9. Spending more time outdoors will always relieve the symptoms of an indoor air quality problem.	❑ True	☑ False
10. It is very easy to tell if someone is sick because of bad indoor air.	❑ True	☑ False
11. People spend as much as 90 percent of their time indoors.	☑ True	❑ False
12. Radon smells like rotten eggs.	❑ True	☑ False
13. All indoor air pollutants are artificial.	❑ True	☑ False
14. Carbon monoxide comes from burning fuels.	☑ True	❑ False
15. Carbon monoxide is an odorless, colorless gas that causes serious health problems.	☑ True	❑ False
16. Formaldehyde is a gas that can come from building materials and furnishings.	☑ True	❑ False
17. Opening a window will always solve an indoor air pollution problem.	❑ True	☑ False
18. Secondhand cigarette smoke can cause cancer.	☑ True	❑ False
19. Pesticides only hurt the pests they were designed to kill.	❑ True	☑ False
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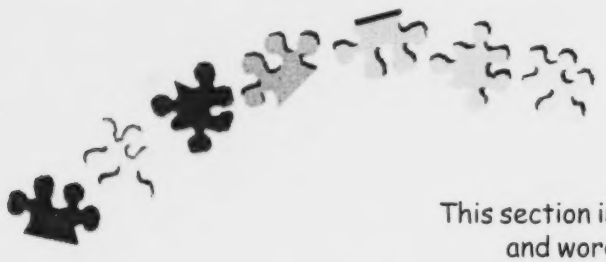
25. Radon is found in household cleaners.	❑ True	☑ False



Vocabulary

This section introduces the common indoor air pollutants and words associated with indoor air pollution. The vocabulary can be introduced all at once or divided up and introduced in the remaining sections, as needed.

Suggested Activities:

Indoor Air Quality Word Find
Indoor Air Quality Word Scramble

Purpose:

To determine the students' familiarity with words associated with indoor air pollution

Objectives:

Students will learn vocabulary associated with indoor air pollution.

Time Needed:

Approximately 30 to 40 minutes

Skill Building:

Vocabulary

Materials:

Index cards

What To Do:

1. Give each student 35 index cards with vocabulary words written on one side.
2. Ask the students if they know the definition of each word.
3. If the students do not know the definition; on one side of the index card have them write the word and the other side the correct definition.
4. Have the students take the index cards home and review them.

Vocabulary

A

Allergic Reactions are symptoms that a person's body has when it is working to rid itself of a perceived invader. Coughing, sneezing, congestion, rashes, swelling, and itching are common symptoms of an allergic reaction.

Asbestos is a naturally occurring mineral fiber. It is flexible and fire-resistant. Asbestos is used in a number of products to strengthen them and provide insulation and fire protection. Asbestos in homes can become a problem if it is disturbed. Cutting, sanding, or other remodeling or removal activities can release asbestos fibers into the air.

Asthma is an illness that causes a temporary blockage of the small airways in the lungs. When someone is having an "asthma attack," the smooth muscles around the airways tighten, causing the airways to become inflamed, narrow, and produce excess mucus. This makes it difficult for air to pass in and out of the lungs.

Atoms are the smallest particles that have all the properties of an element.

B

Biological Contaminants include bacteria, molds, mildew, viruses, animal dander, house dust mites, cockroaches, and pollen. They can cause bad indoor air and damage surfaces inside and outside the home. These pollutants can travel through the air and are invisible.

C

Carbon Monoxide is an odorless, colorless, and highly poisonous gas. Carbon monoxide blocks oxygen in the blood from being delivered to the rest of the body. It is released by burning natural gas, oil, charcoal, gasoline, and tobacco.

Combustion is the process of burning.

Concentration is the amount of a substance contained in a given volume.

Contaminants are substances that have an adverse effect on the air, water, or soil.

D

Data are pieces of information.

E

Elements are the building blccks of the universe. Each element is made up of only one type of atom.

Emissions are substances given off into the air, usually from a source such as smokestacks, cars, and other residential, commercial, or industrial facilities.

Energy is the ability to cause change or do work.

Environmental Tobacco Smoke (ETS) or "secondhand smoke," is a mixture of the particles and gases that are emitted from burning a cigarette, pipe, or cigar, as well as the smoke exhaled by the smoker. Smoke can contain any of more than 4,000 different substances including carbon monoxide and formaldehyde. More than 40 of the substances are known to cause cancer in people or animals and many of them can cause itchy eyes, coughing, and sneezing.

F

Formaldehyde is a colorless, strong-smelling gas. It is widely used in household products, such as glues, wood products, permanent press fabrics, flooring, cabinets, and furniture.

H

Humidity is the amount of water vapor in the air.

Hypothesis is a hunch or guess about what will happen or why something happens that is used to begin a study.

L

Lead is a highly toxic, heavy, bluish gray metal that was used in paints, pipe solder, food cans, gasoline, and in some miniblinds. You can be exposed to lead through old paint and paint dust, water, food, dirt, and dishes made in some countries.

M

Monitoring involves periodically or continuously watching or testing to collect information.

N

Nitrogen Dioxide is a colorless, odorless gas that can be released by burning fuels and by smoking tobacco products.

O

Organic Chemicals are used in many household products. Paints, varnishes, and waxes all contain organic chemicals, as do many cleaning, disinfecting, cosmetic, degreasing, and hobby products. Fuels are also made up of organic chemicals. All of these products can release organic compounds when they are used, and, to some degree, when they are stored.

P

Particulates are very small pieces of a matter, such as a particle of dust or a fiber.

Pesticides are chemicals used to kill household pests (such as bugs, spiders, and cockroaches). They can also be used on houseplants, pets, wood, and woolen products to keep pests away. Pesticides used outdoors may be tracked in on the bottom of your shoes.

Picocurie is a measurement for radiation.

Pollutant is anything introduced into the environment that causes problems for people or animals. Air pollutants are unwanted chemicals or other materials found in the air, such as gases, vapors, dust, smoke, or soot. Most pollutants are created as by-products of processes found to be useful.

Pollution is harm caused to the natural environment.

Prediction is a statement in advance of an event. That statement may be based on observation or experience.

R

Radiation is the release of energy in the form of particles and rays.

Radioactivity is the release of energy particles and rays from the breakdown or decay of atoms in certain elements. The energy release can make people sick.

Radon is a naturally occurring colorless, odorless, and tasteless radioactive gas. It is produced by the breakdown of uranium in rocks and soil. Radon can enter homes through cracks in the basement floors and walls and openings around sump pumps, drains, and construction joints.

Radon Detector is a mechanical, electrical, or chemical device designed to find radon levels in homes. Common radon detectors are the charcoal canister, alpha track detector, and electret ion chamber.

Respiration is breathing. Breathing supplies cells with oxygen and takes away carbon dioxide.

S

Secondhand Smoke, see environmental tobacco smoke.

T

Temperature is a measure of how hot or cold something is. Temperature is measured on a definite scale, such as Celsius, Fahrenheit, or Kelvin.

V

Ventilation is the process of circulating stale indoor air to the outside and bringing fresh outdoor air into a building.

IAQ Word Find

Can you find these indoor air pollutants and their health effects?

ASTHMA
BUG SPRAY
CARBON MONOXIDE
CHEMICALS
CIGARETTE
VIRUS
COUGH
DIZZY
DUST MITES
HEADACHES
LEAD
LUNG CANCER
MOLD
RADON
SMOKE
TIRED

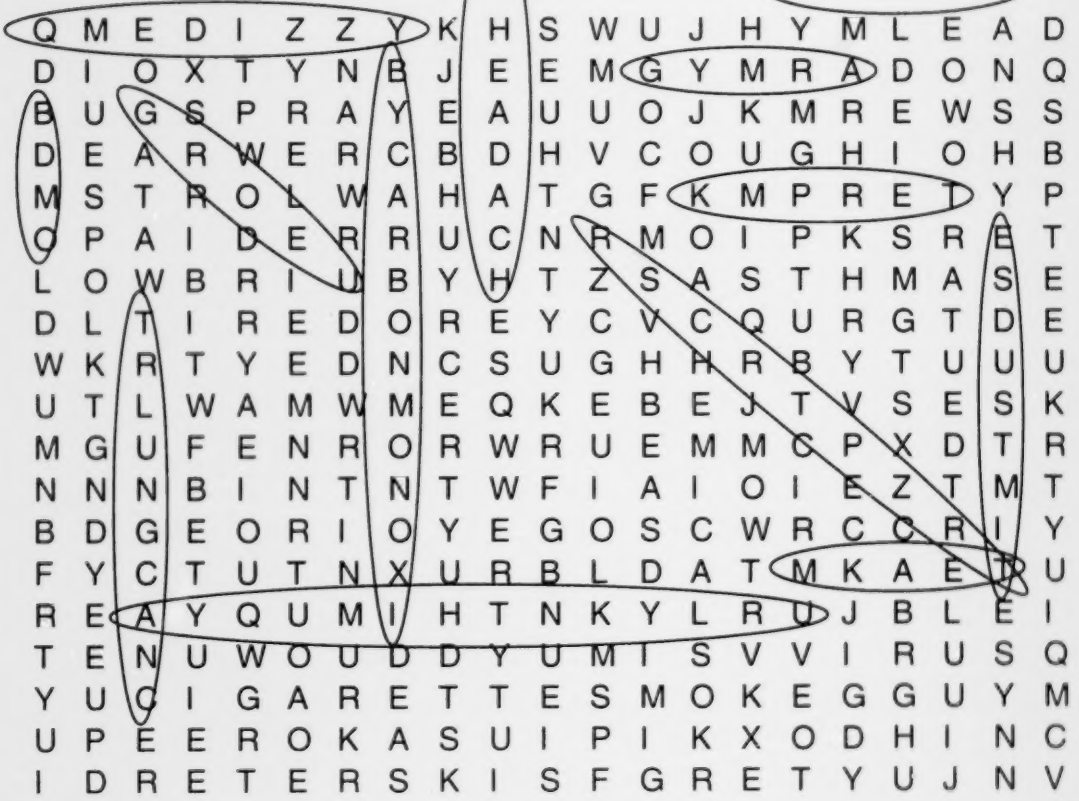
Q M E D I Z Z Y K H S W U J H Y M L E A D
D I O X T Y N B J E E M G Y M R A D O N Q
B U G S P R A Y E A U U O J K M R E W S S
D E A R W E R C B D H V C O U G H I O H B
M S T R O L W A H A T G F K M P R E T Y P
O P A I D E R R U C N R M O I P K S R E T
L O W B R I U B Y H T Z S A S T H M A S E
D L T I R E D O R E Y C V C Q U R G T D E
W K R T Y E D N C S U G H H R B Y T U U U
U T L W A M W M E Q K E B E J T V S E S K
M G U F E N R O R W R U E M M C P X D T R
N N N B I N T N T W F I A I O I E Z T M T
B D G E O R I O Y E G O S C W R C C R I Y
F Y C T U T N X U R B L D A T M K A E T U
R E A Y Q U M I H T N K Y L R U J B L E I
T E N U W O U D D Y U M I S V V I R U S Q
Y U C I G A R E T T E S M O K E G G U Y M
U P E E R O K A S U I P I K X O D H I N C
I D R E T E R S K I S F G R E T Y U J N V

IAQ Word Find Answers

ASTHMA
BUG SPRAY
CARBON MONOXIDE
CHEMICALS
CIGARETTE
VIRUS

COUGH
DIZZY
DUST MITES
HEADACHES
LEAD

LUNG CANCER
MOLD
RADON
SMOKE
TIRED


Q M E D I Z Z Y K H S W U J H Y M L E A D
D I O X T Y N B J E E M G Y M R A D O N Q
B U G S P R A Y E A U U O J K M R E W S S
D E A R W E R C B D H V C O U G H I O H B
M S T R O L W A H A T G F K M P R E T Y P
O P A I D E R R U C N R M O I P K S R E T
L O W B R I U B Y H T Z S A S T H M A S E
D L T I R E D O R E Y C V C Q U R G T D E
W K R T Y E D N C S U G H H R B Y T U U U
U T L W A M W M E Q K E B E J T V S E S K
M G U F E N R O R W R U E M M C P X D T R
N N N B I N T N T W F I A I O I E Z T M T
B D G E O R I O Y E G O S C W R C C R I Y
F Y C T U T N X U R B L D A T M K A E T U
R E A Y Q U M I H T N K Y L R U J B L E I
T E N U W O U D D Y U M I S V V I R U S Q
Y U C I G A R E T T E S M O K E G G U Y M
U P E E R O K A S U I P I K X O D H I N C
I D R E T E R S K I S F G R E T Y U J N V

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IAQ Word Scramble

Unscramble these words about indoor air quality:

1. TSBESAOS _ _ _ _ _ _ _ _ _
2. ALDE _ _ _ _
3. LOMD _ _ _ _
4. DNORA _ _ _ _ _
5. BRCANO OODMIXNE _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
6. HASTAM _ _ _ _ _ _
7. ECRCAN _ _ _ _ _ _
8. HCGOU _ _ _ _ _
9. FVREE _ _ _ _ _
10. YALGERL _ _ _ _ _ _ _

20

IAQ Word Scramble Answers

1.	TSBESAOS	ASBESTOS
2.	ALDE	LEAD
3.	LOMD	MOLD
4.	DNORA	RADON
5.	BRCANO OODMIXNE	CARBON MONOXIDE
6.	HASTAM	ASTHMA
7.	ECRCAN	CANCER
8.	HCGOU	COUGH
9.	FVREE	FEVER
10.	YALGERL	ALLERGY

Major Indoor Pollutants

This section explains the major indoor pollutants and their sources and health effects. Health effects are also covered in the next section, Your Body. Teachers may want to combine these sections.

Suggested Activity:

Indoor Air Quality Matching Game

Vocabulary Words:

allergic reaction, asthma, radiation, radioactivity

Purpose:

To determine how much the students know about the major indoor pollutants and their sources and health effects

Objective:

Students will become aware of the origin and health effects of indoor air pollutants.

Time Needed:

Approximately 30 minutes.
The matching game should take approximately 10 minutes, and the rest of the time should be used for discussion.

Skill Building:

Analysis skill

Materials:

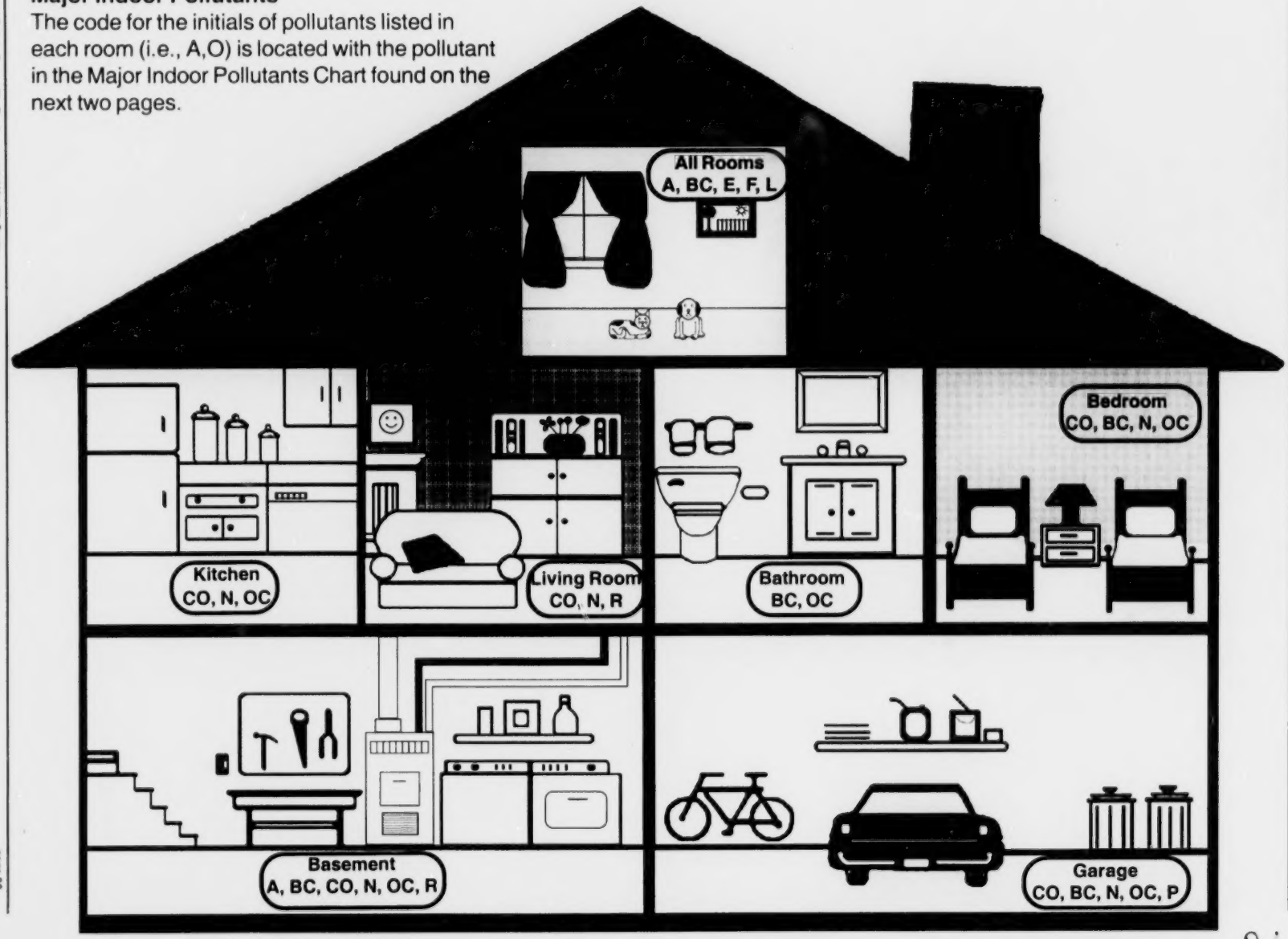
Copy Matching Game for each student.

What To Do:

1. Hand out Matching Game to each student.
2. Have each student match the pollutant to its source.
3. Discuss their answers with them.

Major Indoor Pollutants

The code for the initials of pollutants listed in each room (i.e., A,O) is located with the pollutant in the Major Indoor Pollutants Chart found on the next two pages.



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Major Indoor Pollutants

Pollutant Name	Description	Sources	Signs/Health Effects
Asbestos (A)	mineral fiber	deteriorating, damaged, or disturbed insulation, flooring, siding, and roofing	lung scarring cancer and lung cancer
Biological Contaminants (BC)	bacteria, molds, viruses, mildew, pollen, cockroaches, dander, dust mites	wet or moist walls, ceilings, carpets, or furniture; air conditioners and humidifiers; bedding; household pets	eye, nose, and throat irritation, shortness of breath, dizziness, fever, digestive problems, infectious diseases, asthma
Carbon Monoxide (CO)	colorless, odorless gas	unvented kerosene and gas space heaters, environmental tobacco smoke, fireplaces and chimneys, furnaces, motor vehicles, gas stoves	fatigue, chest pain, impaired vision and coordination, headaches, dizziness, confusion and disorientation, nausea, death
Environmental Tobacco Smoke (E)	mixture of materials in smoke	cigarettes, pipes, or cigars, exhaled smoke	eye, nose, and throat irritation, headaches, lung cancer, respiratory and ear infections, heart disease, asthma
Formaldehyde (F)	chemical used in industry, by-product of combustion	pressed wood products, glues, cabinets and furniture, permanent press clothing, insulation, environmental tobacco smoke	eye, nose, and throat irritation, wheezing and coughing, fatigue, skin rash, severe allergic reaction, may cause cancer

Pollutant Name	Description	Sources	Signs/Health Effects
Lead (L)	toxic metal	lead-based paint and dust, solder on pipes and food cans, contaminated soil, drinking water	in adults: increase in blood pressure, kidney damage, digestive and reproductive problems in children: hearing, growth, and learning problems, lack of coordination; hyperactivity
Nitrogen Dioxide (N)	colorless, odorless gas	kerosene heaters, gas stoves and furnaces, environmental tobacco smoke	eye, nose, and throat irritation; shortness of breath; increased risk of respiratory infection and disease
Organic Chemicals (OC)	ingredients in household products	paints, hobby supplies, aerosol sprays, cleaners, automotive products, dry-cleaned clothing, disinfectants	eye, nose and throat irritation, headaches, dizziness, visual disorders, memory impairment, damage to central nervous system and kidneys, possible increased risk of cancer
Pesticides (P)	toxic chemicals	bug sprays, lawn and garden treatments, rodent sprays, flea and tick powders	eye, nose, and throat irritation, muscle twitching, nausea, headaches, damage to central nervous system and liver, increased risk of cancer
Radon (R)	colorless, odorless, radioactive gas	rocks and soil beneath the home, well water	second leading cause of lung cancer in the United States

Matching Game

Draw a line from the indoor air pollutant to its sources.

Environmental Tobacco Smoke	Uranium in soil
Pesticides	Paint, dust, and pipes
Lead	Cleaning products, disinfectants
Biological Contaminants	Cigarettes and exhaled smoke
Formaldehyde	Stoves, furnaces, and fireplaces
Organic Chemicals	Fibers in insulation and flooring
Asbestos	Pet dander, mold, mildew, viruses
Radon	Pressed wood building materials
Carbon Monoxide	Sprays and powders used on the lawn and garden or around the house

Matching Game Answers

Environmental Tobacco Smoke	Cigarettes and exhaled smoke
Pesticides	Sprays and powders used on the lawn and garden or around the house
Lead	Paint, dust, and pipes
Biological Contaminants	Pet dander, mold, mildew, viruses
Formaldehyde	Pressed wood building materials
Organic Chemicals	Cleaning products, disinfectants
Asbestos	Fibers in insulation and flooring
Radon	Uranium in soil
Carbon Monoxide	Stoves, furnaces, and fireplaces

Room-by-Room

This section goes through each room in a house, highlights potential sources of pollution, and recommends solutions to help prevent an indoor air quality problem.

Suggested Activities:

- Room-By-Room
- Case Study Dilemmas
- Indoor Air Quality Case Studies
- Radon Maze

Vocabulary: All words

Purpose:

To have students be able to point out sources of indoor air pollutants in each room of their home and know what can be done to prevent an indoor air quality problem

Objective:

Students will try to find the sources of indoor air pollutants. They should be able to share what can be done to prevent an indoor air quality problem with their parents or guardians.

Time Needed:

Homework assignment: Approximately 1 to 2 hours, depending on the number of items (Some of the activities, such as testing for radon or lead-based paint, may require a little bit of time over several evenings). Discussion: Approximately 40 to 45 minutes.

Skill Building: Detection and sharing of knowledge

Materials:

1. Copy room checklists and the statement for students.
2. Attach the Statement for Students to each copy of the checklist.

What to Do:

1. Divide students into six groups and assign each group a room(s) to go through with their parents or guardians. You may want to assign each group a specific room, as well as the list that applies to all rooms of the home. Keep in mind that not all of the rooms are applicable to all students (for example, some students will not have a garage or basement). However, the items normally found in these areas (like the furnace) may be found in other areas of the home instead. It is important to point this out to students.
2. Stress the importance of having adult supervision while completing this assignment. Some of the activities can be hazardous to the students if they are not properly supervised. Also, the activity contains advice for both the students and their parents.
3. Give the students several nights or a weekend to complete their rooms. Some parents may not be available in the evenings.
4. Instruct the students to have their parents sign the sheet saying that they helped their child complete the assignment.
5. When the activity is complete, discuss it with the students. Did their parents learn anything? Did they find many problems in their home?

Room-by-Room

Instructions for Students:

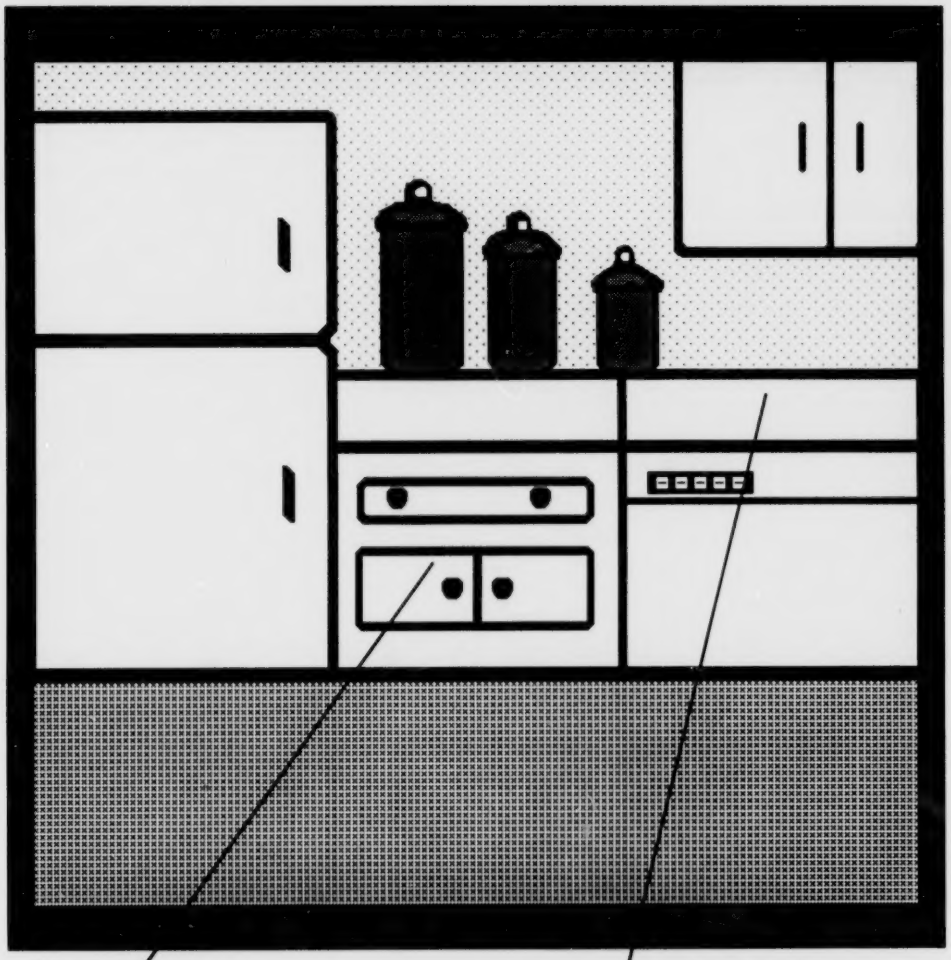
This exercise will help you to check your home for potential sources of indoor air pollution and share what you have learned with your parents. Go through your assigned room(s) and the potential sources with an adult. Some of the activities can be hazardous if you attempt them on your own. If you live in an apartment, some of the suggestions may need to be performed by a building maintenance person. Have your parents check with the landlord about these items.

Each room has its own checklist of activities for you to complete and potential solutions or recommendations for adults. Both you and your parent or guardian should sign the checklist once it is completed.

Kitchen

PROBLEM SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Gas appliances:		
Carbon Monoxide Nitrogen Dioxide	If your home has a gas stove, does it have a fan that vents pollutants to the outside?	If it does not currently have a fan, a window exhaust fan should be used while cooking.
	Have an adult turn on the gas range burner so you can look at the flame. What color is the flame?	The flame should be blue, if the tip of the flame is yellow or orange, the range needs to be adjusted.
	Does the range have a pilot light?	If your family is getting a new gas appliance, buy a model that uses spark ignition (an electric starter) rather than pilot lights (a continuously burning flame), or choose an electric appliance instead.
	Is the range used for any activity other than cooking?	Gas ovens should never be used to heat the home.
Cleaning products:		
Organic Chemicals	With help from an adult, find a few cleaning products (dishsoap, window cleaner, etc.). Read the directions carefully. Are the directions always followed when the product is used?	Use pump-type products instead of aerosols when possible.

Kitchen



Cleaning Products:
Organic chemicals are present in products used in and around the home, such as dishsoap, window cleaner, etc.

Gas Appliances:
Carbon monoxide is produced as a result of incomplete burning of fuels.

Nitrogen dioxide is produced as a result of incomplete burning of fuels.

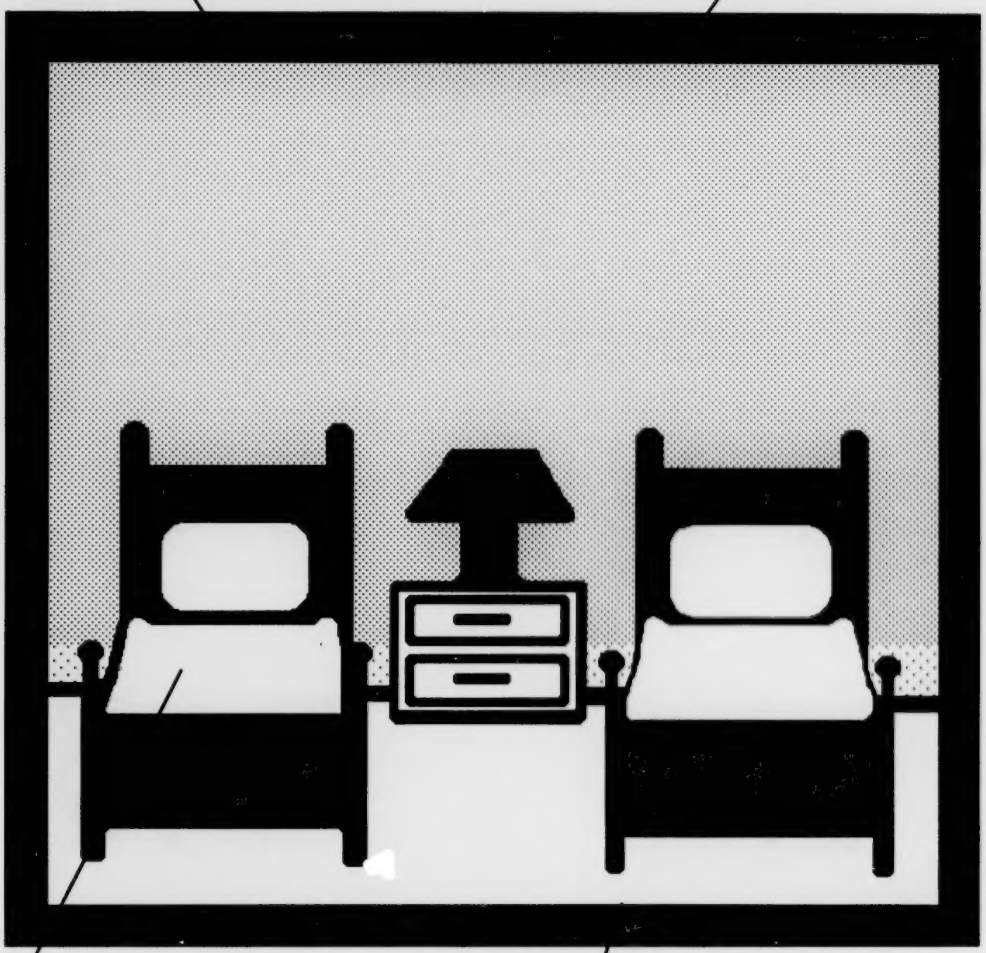
Bedroom

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Kerosene heater: Carbon Monoxide Nitrogen Dioxide	Does anyone in your home use a kerosene or gas heater? Is it vented outside of the home?	If you use a space heater make sure it is vented to the outside. If the space heater is older than 1982, you should replace it with a newer one. Space heaters manufactured after 1982 have an oxygen depletion sensor that shuts off the heater when there is not enough fresh air in the room.
Dry-cleaned goods: Organic Chemicals	Does your family have their clothes dry-cleaned? Do they have bedspreads or drapes dry-cleaned?	Don't accept clothes that have a chemical odor. Remove dry-cleaned goods from the plastic as soon as possible to let them air out.
Moth repellants: Organic Chemicals	Does your family use moth repellants (usually moth balls) when storing items? Help your parents replace any moth repellants with cedar. The scent of cedar wood will keep moths away.	Use cedar instead of other moth repellants. Keep the moth repellant containers away from areas where your family spends a lot of time. If your house has an attic or storage closet, keep the items there. When using moth repellants, avoid breathing in the smell.
Bedding: Biological Contaminants	Do your parents wash your bedding regularly, (every seven to ten days)?	Wash bedding in hot (130°F) water to kill the dust mites.

Bedroom

Dry-Cleaned Goods:
Organic chemicals are used to clean clothing, bedding, drapes, etc.

Moth Repellants:
Organic chemicals are present in products used to keep moths away from clothes.



Bedding:
Biological contaminants include dust mites and dander.

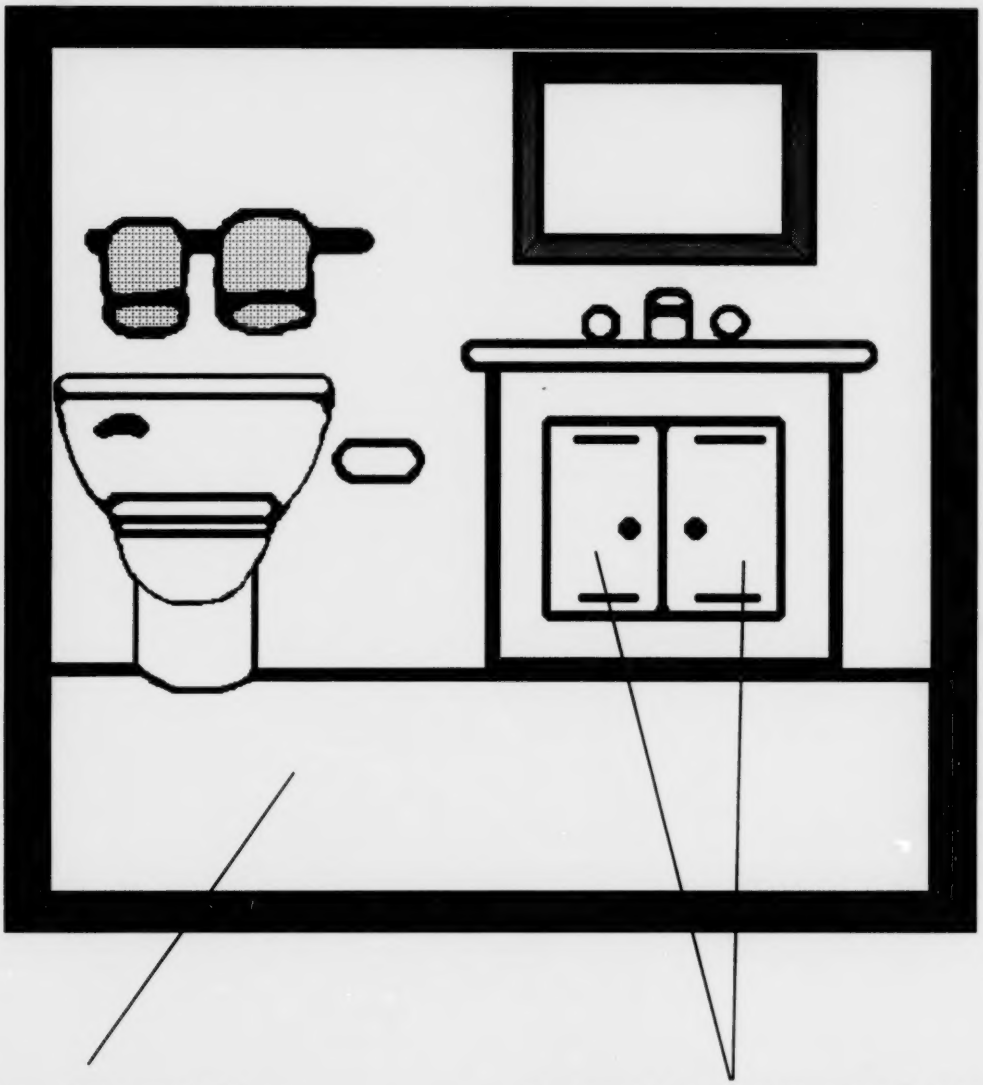
Unvented Space Heater (Kerosene or gas):
Carbon monoxide is produced as a result of incomplete burning of fuels.

Nitrogen dioxide is produced as a result of incomplete burning of fuels.

Bathroom

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Personal care and cleaning products:		
Organic Chemicals	What are some personal care and cleaning products used in the bathroom? Read and discuss the directions on the labels of each product. Follow the directions carefully whenever you use these products.	Use pump-type products instead of aerosols whenever possible.
Moisture, mold, and mildew:		
Biological Contaminants	Do the bathrooms in your home have mold or mildew? Look for discolorations of the tiles, floor, walls, and ceiling. When showering or bathing, run the exhaust fan in the bathroom to cut down on moisture buildup. If you don't have an exhaust fan, open a window a little bit or leave the bathroom door open a couple of inches to let moisture escape. Are there any plumbing leaks?	Clean up any evidence of mold immediately. Have plumbing leaks fixed as soon as possible.

Bathroom



Moisture, Mold, and Mildew:
Biological contaminants grow because of the wet and humid conditions

Personal Care and Cleaning Products:
Organic chemicals are present in cleaning and personal care products (e.g., hair spray, hair dye, nail polish remover, etc.)

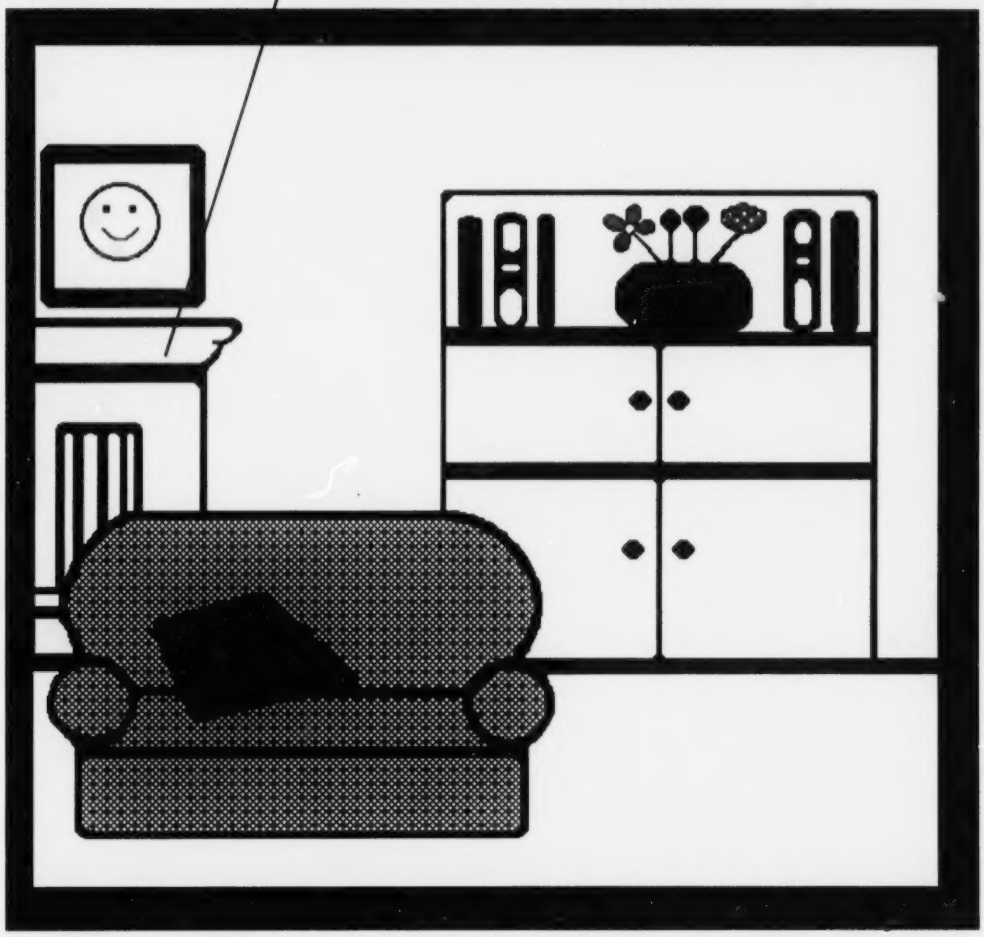
Living Room

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Fireplace: Carbon Monoxide Nitrogen Dioxide	Does your home have a fireplace? How often is the chimney cleaned?	Open the flue before lighting the fire and keep it open until the ashes have completely cooled down. Throw out the ashes once they have cooled. Have the flue and chimney cleaned regularly to avoid a build-up of soot. To prevent backdrafting (smoke coming back in), have a source of fresh air (a window or door cracked open).
Wood or coal stove: Carbon Monoxide Nitrogen Dioxide	Does your house have a wood or coal stove? Is it properly vented to the outside?	Have a professional inspect the stove regularly to make sure that the stove is properly vented to the outside air and that the exhaust system is working efficiently.

Living Room

Fireplace or Wood or Coal Stove:
Carbon monoxide is produced as a result of the incomplete burning of fuels. If the flue or chimney becomes blocked, carbon monoxide can build up inside the house.

Nitrogen dioxide is produced as a result of the incomplete burning of fuels.



Basement or Ground Level

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Insulation around furnace and water heater pipes:		
Asbestos	With the help of an adult, examine the furnace and water heat pipe insulation for damage. DO NOT TOUCH the insulation, especially if it is damaged.	If you think that the insulation may contain asbestos hire a qualified professional to come to the house and find out. Asbestos-containing material should only be worked on by a certified professional. If your home is going to be repaired or remodeled in the area of the asbestos materials, hire a trained asbestos professional to do the work.
Furnaces filters:		
Biological Contaminants Particulates	Look at the air filter on the furnace in your home. Is it dirty? If it is dirty, clean or replace it.	Clean or replace the filter in your furnace once a month (or according to the manufacturer's instructions). Also, clean around all outgoing and return air vents. Have your furnace serviced regularly by a professional (according to the manufacturer's instructions).
Gas furnace, gas water heater, gas clothes dryer:		
Carbon Monoxide Nitrogen Dioxide	Does your home have gas appliances? How often are they serviced and inspected?	Have professionals check that emissions are being properly vented to the outside and that the vents are clean (no build-up that might inhibit the flow of emissions outdoors).

Basement or Ground Level (continued)

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Radon	With the help of an adult, test your home for radon.	Easy to use, inexpensive test kits are available at hardware stores, through some local government and community groups, and from the Radon Hotline (800-SOS-RADON). If the test shows that the radon levels are 4.0 picocuries per liter (pCi/L) or higher, your home needs to be fixed. If you cannot fix your home, try to spend as little time in the basement as possible, where radon concentrates. If weather permits, open windows to air out the basement (this action may bring levels down temporarily). Keep inside doors leading to the basement closed as much as possible.
Ground/air moisture: Biological Contaminants	Is your basement dry? With the help of a parent, check the basement for moisture and mildew. Help your family keep the basement floor clean by sweeping and vacuuming it regularly.	The basement floor needs to be kept clean. If the basement is humid, damp, or wet, you may need to use a dehumidifier to get rid of the excess water and water vapor. Disinfect damp floors regularly to prevent mold and mildew.
Stored hobby products: Organic Chemicals	Do you have paint, varnish, glues, mineral spirits, and similar products stored in your basement? When using these products, follow the directions carefully. When using them indoors, open a window or use an exhaust fan to vent the pollutants. When finished, reseal the containers tightly and carefully clean all brushes and other reusable materials.	Read and discuss directions on a few of these products found in your home. If possible, store these materials outside, or away from the main areas of your home.

Basement

Ground/Air Moisture:
Biological contaminants include mold and mildew growing because of damp or wet conditions.

Stored Hobby and Cleaning Products:
Organic chemicals are present in glues, paints, cleaners, and similar products used in various tasks in and around the house.

Insulation Around Furnace and Water Heater Pipes:
Asbestos may be present in older insulation.

Furnace Filter:
Dust, mold, mildew, dust mites, and other contaminants can be trapped by the furnace filter as it cleans the air.

Radon:
Radon enters the home through cracks and other openings in the floor and walls, unsealed sump pumps, and improperly sealed drains.

Gas Furnace, Gas Water Heater, Gas Clothes Dryer:
Carbon monoxide is released as a result of incomplete burning of fuels.

Nitrogen dioxide is released as a result of incomplete burning of fuels.

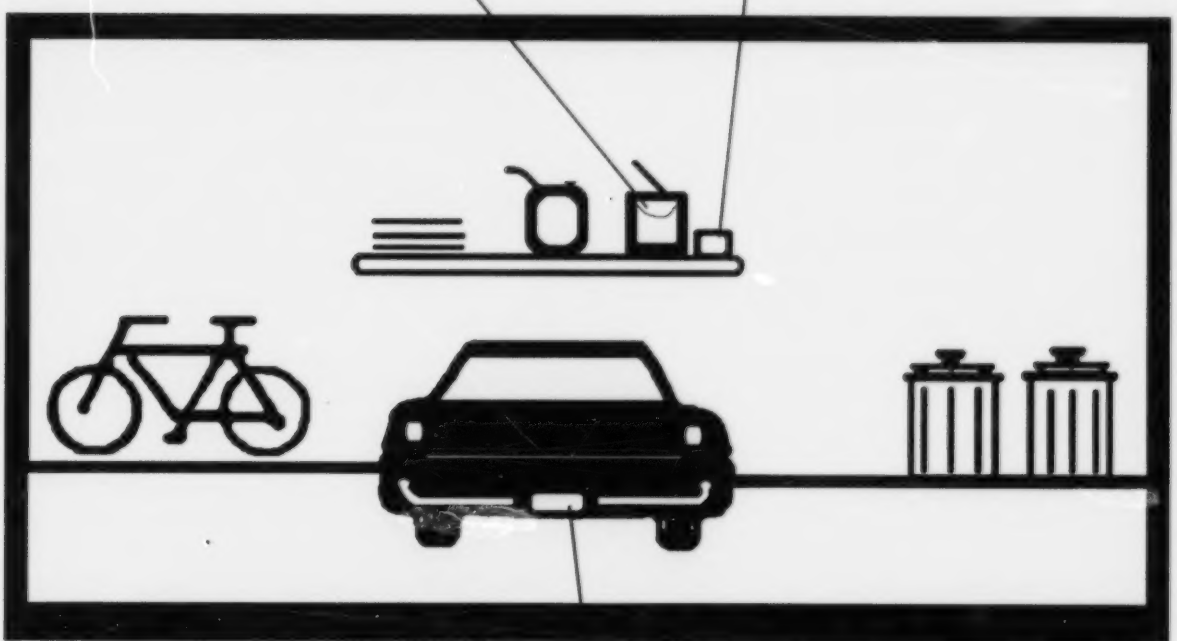
Garage

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Cars, lawn mowers: Carbon Monoxide Nitrogen Dioxide	Is the door from your house to the garage air tight? Help an adult install weather stripping on the bottom of the door from the garage to the home. This will help keep emissions from getting into the house.	Never leave cars or gasoline-powered lawn mowers running in a garage or any other enclosed space.
Paint/ home improvement supplies: Organic Chemicals	Do you have paint, caulk, mineral spirits, paint thinner, or similar products in your garage? With an adult, read and discuss the directions on a few home improvement supplies. Never handle these items without adult supervision.	When using any home improvement supplies, follow the directions carefully. Use paint brushes instead of paint sprayers. Paint sprayers waste a lot of paint and they put tiny droplets of paint into the air that can be hazardous to your health when breathed in. Reseal all containers well and wash any used brushes carefully.
Pesticides	Where are pesticides used in your home? With an adult, read and discuss the directions on the pesticides used around your home. Do not use these items without adult supervision.	Be sure to carefully follow the directions when applying pesticides in or around your home. When applying pesticides to plants or pets, take them outside and leave them outdoors until the pesticide dries. Thoroughly clean your hands and shoes so you won't bring the pesticide indoors. Try nontoxic alternatives. Contact your local garden center for more information.
Barbecue: Carbon Monoxide Nitrogen Dioxide		Never barbecue in a garage or any other enclosed space.

Garage

Paint, Home Improvement Supplies:
Organic chemicals are present in paints, varnish, paint thinners, and similar products used in and around the home.

Pesticides:
Used to control pests in and around the home.



Cars, Lawn Mowers, Gas/Kerosene Barbecues:
Carbon monoxide is produced as a result of incomplete burning of fuels.

Nitrogen dioxide is produced as a result of incomplete burning of fuels.

All Rooms

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Air conditioners, humidifiers, and dehumidifiers:		
Biological Contaminants Particulates	Does your home have an air conditioner, humidifier, or dehumidifier? Help your family clean these appliances and their filters regularly.	Have these appliances serviced regularly, according to the manufacturer's instructions. Use only distilled or demineralized water in humidifiers.
Carpets:		
Formaldehyde Biological Contaminants	Does your home have carpeting? Carpets should be kept clean and dry, and vacuumed weekly.	If the carpet becomes soaked, it must be dried within 24 hours or it should be replaced. If you plan to purchase new carpet, ask the carpet retailer for information on carpet emissions. Also, ask if the carpet can be aired out prior to installation. If glue is needed for installation, a low-emitting glue should be used. When the carpet in your home is being replaced, everyone should leave for the time during and immediately after installation. For 48 to 72 hours after installation, keep all fans and ventilation equipment on to exhaust the fumes. If odors persist, contact your carpet retailer. Carpets collect a lot of dust. Wherever possible, have hardwood floors with area rugs instead of wall-to-wall carpet. Wash throw rugs regularly.

All Rooms (continued)

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Environmental tobacco smoke (ETS)	Does anyone in your home smoke? Avoid being in a room where people are smoking.	Smoking around your children is harmful to their health. Do not let anyone smoke inside the home. If someone insists on smoking indoors, open a window or turn on an exhaust fan to vent the smoke.
Floor tiles: Asbestos	Does your home have floor tile? Are they in good condition?	Old floor tiles may contain asbestos. Damaged tiles should be inspected and replaced by a professional.
Draperies and other window treatments: Biological Contaminants	Do you help your parents vacuum, dust, and clean regularly to keep down pollen, dander, dust, and dust mites?	Keep drapes and other window treatments clean to kill dust mites and reduce pollen, dander, and particulates.
Lead in paint, dust, soil and water	What year was your home built? Homes built before 1978 may contain lead-based paint. If your home was built before 1978, do not touch any chipping or peeling paint. Wash your hands before each meal, before bedtime, and when coming in from playing outdoors. With an adult's help, contact your state housing department for information on how you can test the paint for lead. If you do find lead in the paint, it should only be removed by a professional trained in lead removal.	Homes built before 1978 may contain lead-based paint. When this paint deteriorates or is disturbed, it creates lead dust. This dust is harmful when inhaled or swallowed. Children under 6 and pregnant women are more easily harmed by lead than others. To minimize the chances of exposure, areas where children play should be kept as dust-free as possible. Floors, window ledges, and chewable surfaces should be

All Rooms (continued)

PROBLEM/SOURCE	ITEMS TO CHECK (KIDS)	SOLUTIONS/ RECOMMENDATIONS (ADULTS)
Lead (cont.)		Be sure your children eat a balanced diet high in iron and calcium. This diet will help them absorb less lead, if they are being exposed to it.
Pets:		
Biological Contaminants	Does your family have pets? Taking proper care of pets can help reduce their contribution to poor indoor air quality. Many people are allergic to pet hair and dander (dead skin cells and saliva). Vacuum furniture and carpets to keep down hair and dander. Follow these simple steps to take care of the family pets: • Brush your pet daily to reduce shedding. If your pet is not used to being brushed, start with a few strokes a day and work up to more. • Bathe dogs regularly with warm water and an appropriate shampoo to remove dander and other allergens. Give cats plain water baths every few weeks. • Feed your pet a balanced diet to keep their hair and skin healthy. If you have pets in cages, clean cages regularly and thoroughly. Try not to let pets wander around the house. Keep pets out of the bedrooms.	Help your children keep pets clean, healthy, and free from fleas, ticks, and dander.
Windows:		
Biological Contaminants		Open doors and windows as often as possible to maintain moderate humidity and temperature, and to let fresh air in.

All Rooms

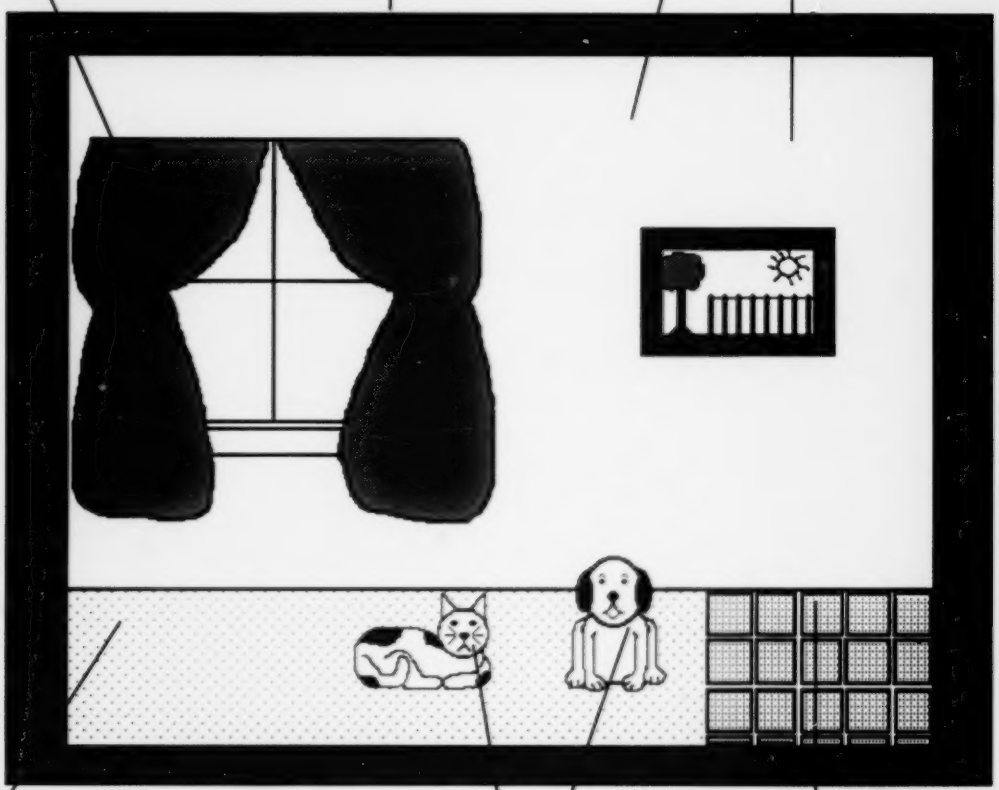
Draperies and Other Window Treatments:
Biological contaminants collect dust and pollen and allow dust mites, mold, and mildew to live and grow.

Environmental Tobacco Smoke:
Smoke comes from the burning end of a cigarette, pipe, or cigar, and when smokers exhale smoke.

Air Conditioners, Humidfiers, and Dehumidifiers:
Biological contaminants (mold and mildew) can grow inside these appliances and be released into the air.

Particles (dust) can be circulated by the system.

Lead:
Lead is found in paint and dust.



Carpet:
Formaldehyde is used in making the carpet and the adhesives.

Biological contaminants (mold, mildew, and dust mites) can live and grow in carpets.

Floor Tiles:
Asbestos is used in making floor tiles.

Pets:
Biological contaminants include pet dander, hair, and saliva.

Case Studies on Indoor Air Quality Problems

Purpose:
To have students present solutions to indoor air quality problems

Objective:
Students will be able to use their knowledge of indoor air pollution to develop and present solutions to indoor air quality dilemmas.

Time Needed:
40 to 45 minutes

Skill Building:
Problem solving

Materials:
Index cards

What To Do:

Before Class:

1. Copy the Case Study Dilemmas onto index cards.
2. Read fact sheets on radon, lead, asthma, and biological contaminants (see Section 9).

When Class Begins:

1. Divide the class into 4 or more groups and give one dilemma card to each group. If you have more than 4 groups, some groups will have the same card. Solutions to the dilemmas may vary.
2. Have students appoint one person in each group as the recorder. Give that person a blank sheet of paper to record the group's answers.
3. Tell the students that they are going to use their knowledge of indoor air quality issues to solve some "indoor air quality dilemmas." Remind students that there may be more than one solution to each problem, and they should try to discuss all possibilities.
4. Allow enough time for the students to discuss at least two solutions.
5. Have each group read their dilemma and solutions out loud. Discuss everyone's answers. Encourage other students to question and comment on their classmates' ideas.
6. Solutions to each dilemma are presented on a separate sheet. The italicized sentences are the solution(s). The rest is further information. Try to include this information in the discussion.

Case Study Dilemmas

Dilemma #1

The Jones Family is looking for a new home to buy in any town, USA. They have found a house that they all love. It's close to schools and shopping. The house has a bedroom for each child, a pool, and a big backyard with lots of trees. Unfortunately, the house has a radon level of 20 picoCuries per liter of air. This makes Mr. and Mrs. Jones nervous. What can they do to make their dream home safe?

Dilemma #2

Susie has been learning about lead in her 5th grade class. Susie lives in an old home that has a lot of peeling paint, and her parents are talking about fixing up the house. Susie's mom is about to have another baby. Susie is worried about the lead paint hurting her mom and the new baby. What can Susie ask her family to do to help protect them?

Dilemma #3

Don puts together and paints model airplanes as a hobby. His parents complain that whenever he works on his airplanes, the house smells like glue and paint. What are some steps that Don can do to reduce the smell?

Dilemma #4

John has asthma. His family has two dogs and a cat . His house also has wall-to-wall carpeting in most rooms. List things that John and his family can do to keep his asthma from getting worse.

Case Study Dilemma Solutions

Dilemma #1: *The Jones should hire an EPA-listed contractor to come and fix their new home.*

The most effective way to fix radon problems is with a method called sub-slab ventilation. A pipe with holes in it is installed under the floor of the basement. It is attached to a pipe that runs up through the house to 12 inches above the roof. The system may or may not have a fan, which is usually in the attic just below where the pipe leaves the house. This system draws the radon out from under the slab and sends it to the outside air. For more information call EPA's Radon Helpline at (800) 55-RADON. For a list of EPA-listed contractors call the Radon Fix-It Hotline at (800) 644-6999 or visit EPA's Web page at http://www.epa.gov/iaq.

If the Jones can't afford to have this work done, they should reduce their exposure to radon and their risk as much as possible. They can do this by spending as little time as possible in the basement, opening windows whenever possible, and not smoking (smoking also causes lung cancer).

Dilemma #2: *Susie and her family should have their home tested for lead-based paint.*

The family should contact their state housing department for information on how to get their home tested. The family should not attempt to remove the paint on their own. Only certified lead removal technicians should perform lead removal tasks. In the meantime, the family (especially children under 6 years of age and pregnant women) can follow some simple precautions to help reduce the risk of lead poisoning:

- *Eat a diet high in iron and calcium.* These minerals help reduce the amount of lead that is absorbed into the body.
- *Wash hands before meal time and bedtime.*
- *Wash floors, window ledges, and chewable surfaces with soap and water.*
- Contact the National Lead Information Center at (800) 424-LEAD for more information on lead.

Dilemma #3: *Don should open some windows when he works on his models. He should also try to work away from living areas of the home, in the basement or garage, if possible. Less toxic alternatives to the glue and paint may be available at hobby shops.*

Dilemma #4: John and his family should do the following:

- *Regularly consult with John's doctor or allergist about his asthma.*
- *Vacuum and dust thoroughly and often. Empty the vacuum bag frequently.*
- *Groom pets daily to reduce shedding.*
- *Bathe dogs regularly with warm water and a good shampoo. Bathe cats with plain water every few weeks.*
- *Wash John's bedding weekly in 130°F water.*

Radon Maze

Purpose:

To figure out a way for radon to escape the house

Objective:

Students will learn why and how radon should exit the house.

Time Needed:

Approximately 25 minutes, 10 minutes to attempt the maze and 15 minutes for discussion

Skill-building:

Eye-hand coordination
Fine motor skills

Materials:

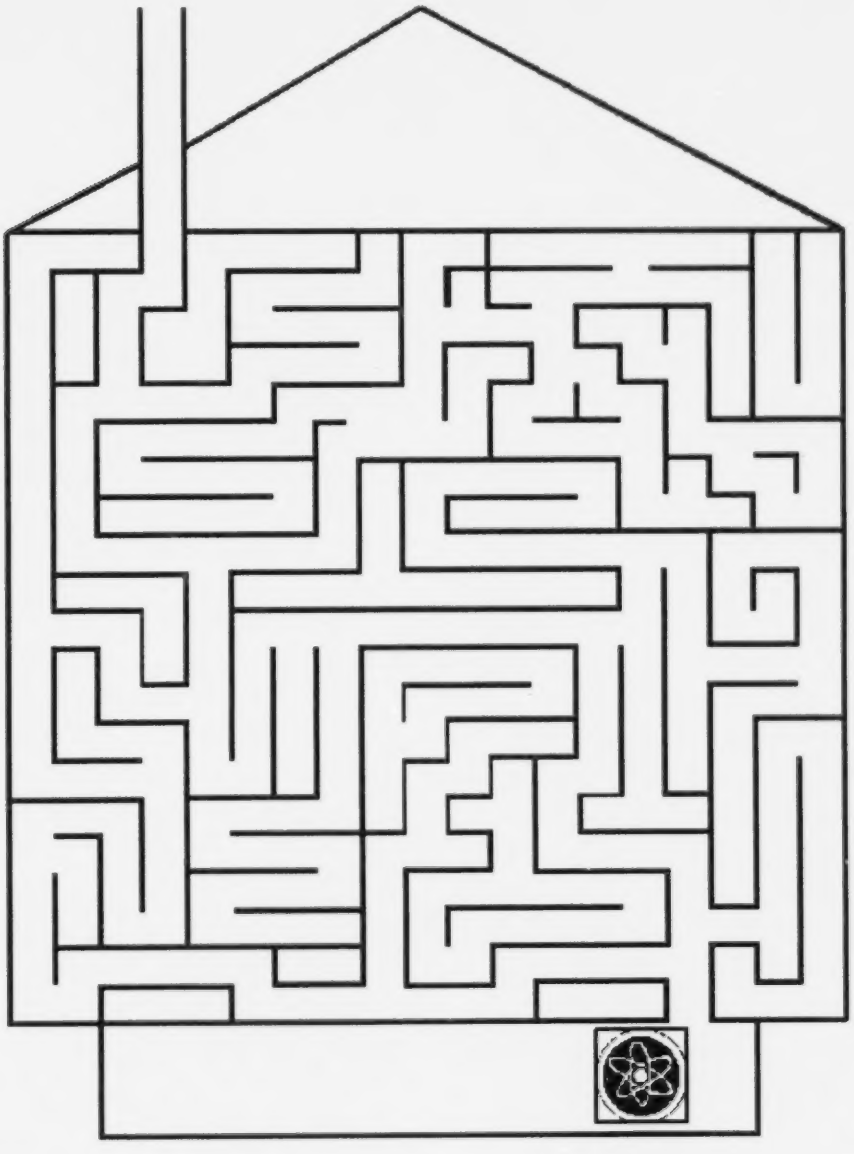
Copy Radon Maze worksheet for each student.

What To Do:

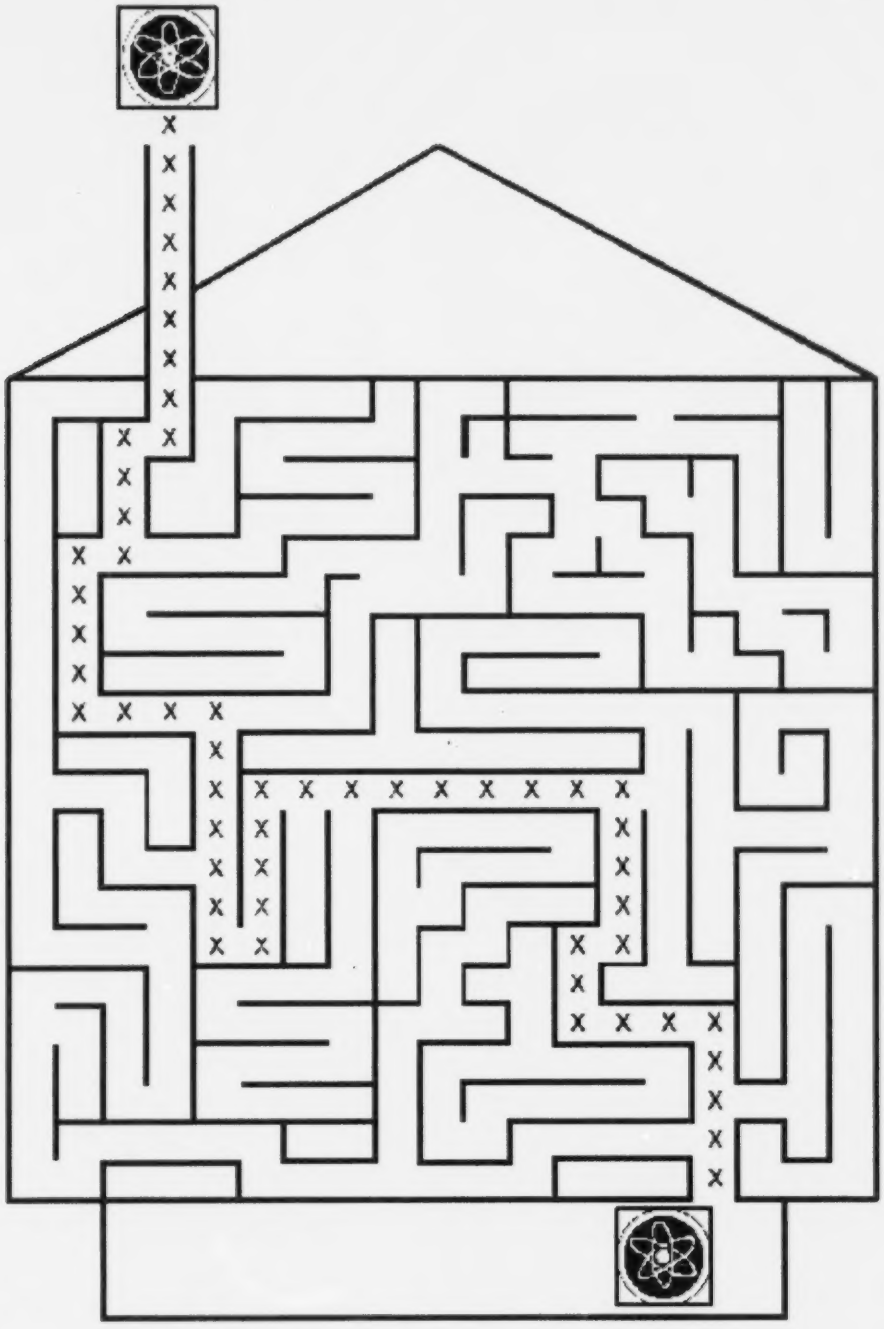
1. Give each student a Radon Maze worksheet.
2. Give them 10 minutes to figure out the maze.
3. Ask how many students figured how the radon exits the house.
4. Discuss why radon should have an escape route.

Radon Maze

Keep radon from hurting your family. Help it escape from the basement of your house.



Radon Maze Answer Key



Your Body

This section highlights why and how the pollutants affect our bodies.

Suggested Activities:

How Pollutants Affect the Body
Body Parts Diagram
Health Effects Case Study

Vocabulary:

allergic reaction, asbestos, asthma, biological contaminants, carbon monoxide, environmental tobacco smoke, formaldehyde, lead, nitrogen dioxide, organic chemicals, pesticides, radon

Purpose:

To determine what your students know about the effects of indoor air pollution on the body

Objective:

Students will be able to list indoor air pollutants, their health effects, and the part(s) of the body that they affect.

Time Needed:

30 minutes

Skill Building:

Cause and effect

Materials:

Copy the body parts diagram for each student or make it into an overhead.

What To Do:

1. This exercise can be used individually, in groups, or as a class.
2. Let the students know that the diagram of the human body has been simplified for the purpose of this exercise.
3. Have students fill in the indoor air pollutant that affects each part of the body and what potential effects each one has.
4. Discuss the answers with the students. An answer key is provided for your reference. Be sure to introduce any points that the students missed.

Your Body

We breathe air into our lungs. Our lungs process every breath we take, about 16,000 quarts of air each day for adults. Our lungs, along with our nose, act as filters, removing some of the larger particles in the air before they get too far into our bodies and harm us. Our lungs also provide oxygen to the blood and remove carbon dioxide from the blood.

Whenever we breathe pollutants, our health may be affected. Most people are aware that outdoor air pollution can make them sick, but they may not know that indoor air can be harmful too. Studies show that indoor air pollution levels are typically two to five times, and occasionally more than 100 times, higher than outdoor levels. Indoor air pollution has been ranked among the top five environmental risks to our health.

Some pollutants, such as tobacco smoke, get past the "filters" and penetrate deep into the lungs. Health effects caused by these pollutants can either be immediate or show up years later. People may feel sick after a single exposure or after repeated exposures. Immediate symptoms include irritation of the eye, nose, and throat, headaches, dizziness, and fatigue. Most immediate effects are short-term and can be treated.

Many of the immediate health effects caused by indoor air pollution are similar to those of a common cold, the flu, or stress. This makes it hard to tell if a person is feeling bad because of an air quality problem, or if there is some other cause. Also, many of the pollutants have similar effects, so it can be hard to pin down which one is causing the problems.

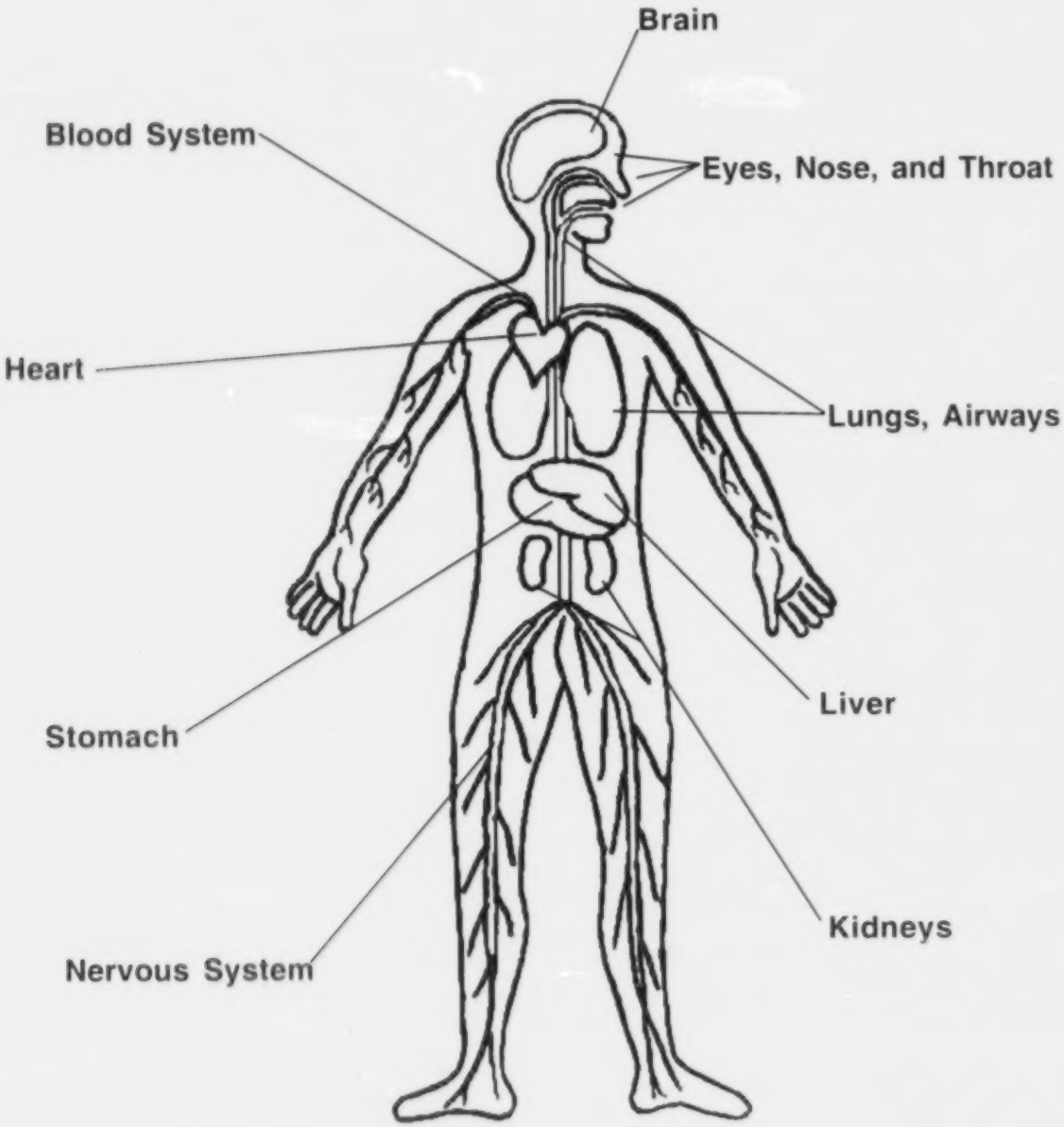
Some pollutants (lead, for example) can affect the brain and the central nervous system. Potential side-effects of lead poisoning in children include delays in mental development, lower intelligence test levels, shortened attention span, behaviorial problems, and, at high levels, brain damage, seizures, and coma. In adults, lead poisoning can cause nerve damage, clumsiness, sleep problems, and, at high levels, uncontrollable shaking of the hands, hallucinations, brain damage, and coma.

Other health effects from indoor air pollutants may show up years after exposure has occurred or only after long or multiple exposures. These effects include damage to the liver and central nervous system, hallucinations, some breathing diseases (e.g., asthma, emphysema), heart disease, and cancer.

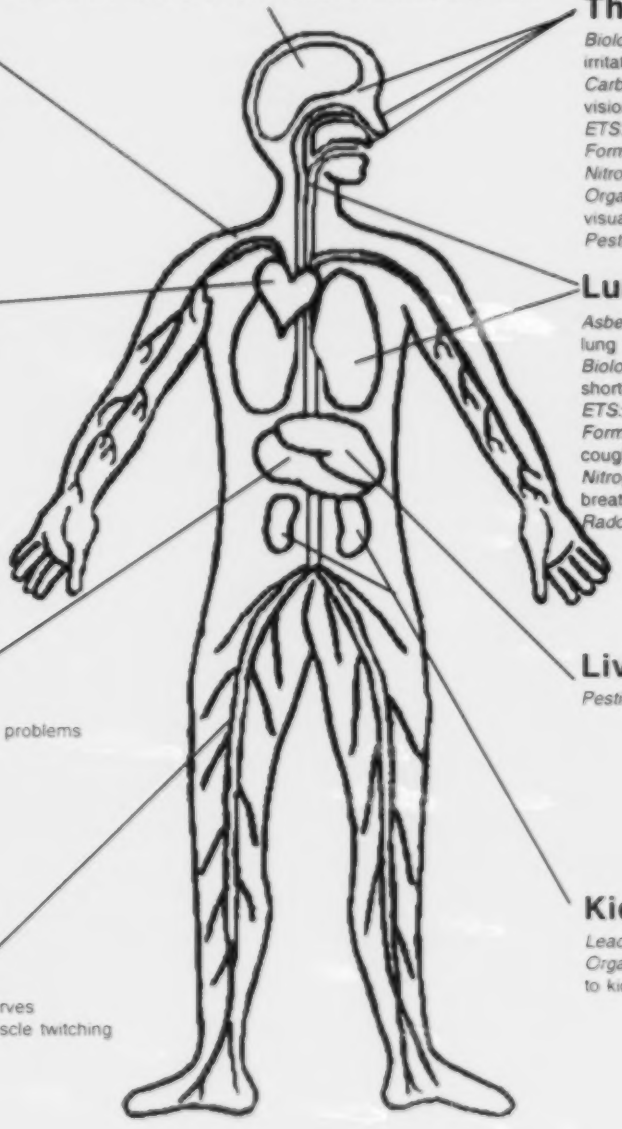
Can pollutants enter the body in other ways? Yes. Pollutants can be ingested (swallowed) or absorbed when they come in contact with your skin. You should never put any chemicals, cleaning products, or pesticides in your mouth. Follow the product's directions carefully and wash your hands thoroughly after using these products.

Body Parts Diagram

Write down the pollutants that affect each part of the body and some of their possible effects.



Body Parts Diagram Answer



Brain

Biological contaminants: dizziness
Carbon monoxide: headaches, dizziness, confusion
ETS: headaches
Lead: learning problems, lack of coordination, hyperactivity
Organic chemicals: dizziness, headaches, memory impairment

Blood System

Biological contaminants: infectious diseases
Carbon monoxide: interferes with delivery of oxygen to blood
Lead: high blood pressure, lead is absorbed into the blood

Heart

ETS: contributes to heart disease

Stomach

Biological contaminants: digestive problems
Carbon monoxide: nausea
Lead: digestive problems
Pesticides: nausea

Nervous System

Lead: nerve disorders
Organic chemicals: damage to nerves
Pesticides: damage to nerves, muscle twitching

Eyes, Nose, and Throat

Biological contaminants: irritation
Carbon monoxide: impaired vision
ETS: irritation, infection
Formaldehyde: irritation
Nitrogen dioxide: irritation
Organic chemicals: irritation, visual disorders
Pesticides: irritation

Lungs, Airways

Asbestos: lung cancer and lung scarring
Biological contaminants: shortness of breath, asthma
ETS: cancer
Formaldehyde: wheezing, coughing
Nitrogen dioxide: shortness of breath, possible infection
Radon: cancer

Liver

Pesticides: damage to liver

Kidneys

Lead: damage to kidneys
Organic chemicals: damage to kidneys

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Health Effects Case Study

Purpose:

To determine what your students know about the health effects and symptoms of indoor air pollution

Objective:

Students will be able to use their knowledge of the health effects of indoor air pollution to identify symptoms and potential causes.

Time Needed:

40 to 45 minutes

Skill Building:

Identification of symptoms and health effects of indoor air pollution.

Materials:

Index cards

What To Do:

Before Class:

1. Copy symptoms onto index cards for distribution.
2. Read fact sheets on biological contaminants, formaldehyde, pesticides, and carbon monoxide.

When Class Begins:

1. Divide the class into four or more groups and distribute one symptom card to each group. If you have more than four groups, some groups will have the same card. Answers may vary because several indoor air pollutants have similar symptoms.
2. Have students appoint one person in each group as the recorder. Give that person a blank sheet of paper to record the answers on.
3. Tell the students that they are going to use their knowledge of the health effects of indoor air pollutants to try to figure out what is causing the symptoms listed on each card. Remind students that there may be multiple answers to each problem, and they should discuss all possibilities.
4. Allow enough time for at least two possibilities to be discussed within each group.
5. Have each group read their scenario out loud, as well as their guesses about the cause. Discuss everyone's answers. Encourage other students to question and comment on their classmates' ideas.
6. Students should also try to develop some ways to solve the problem.

Health Effects Case Study Symptoms

SYMPTOM #1

Harry lives near a river in an area with lots of rain and frequent flooding. This past month, the river overflowed and the first floor of his house had six inches of water in it for several days. The entire house is carpeted. Since the flood, he and his family have been sick. Their noses run, they sneeze a lot, and their throats are sore. What could be causing their symptoms?

SYMPTOM #2

Casey has noticed that whenever she sits in one of the classrooms at school, she feels tired, dizzy, and has trouble concentrating. The classroom just got new pressed-wood desks, wood paneling, and particleboard book shelves. What could be causing Casey's symptoms?

SYMPTOM #3

Once a month, for about a week, when Jenny plays outside she gets a headache, feels really tired, and sometimes feels like she needs to throw up. Once she even developed a rash on her legs. A lawn company comes to the house once a month to spray fertilizer on the lawn. What do you think could be causing her problems?

SYMPTOM #4

Last winter, Dennis was staying at a friend's house when the whole family began feeling tired, and dizzy. His friend's parents got bad headaches and Dennis was sick to his stomach. They all left the house and began feeling better. The fire department came to the house to see what was wrong. The family has gas heat, appliances, and a fireplace. What do you think the firefighters found to be the cause of their sickness?

Health Effects Case Study Answers

Italicized sentences are the points that the groups should be able to come up with.

Symptom #1: *Mold in and under the carpet.*

To prevent mold from growing, water-damaged carpet should be completely cleaned and dried within 24 hours of getting wet. Once mold is present, the best way to get rid of it is to have the carpet replaced and the floor under the carpet disinfected. Any water-damaged cloth furniture should be thoroughly dried and cleaned. If this is not possible, it should be replaced. Also, water-saturated wallboard should be replaced (remove up to 12 inches above the water line).

Symptom #2: *Formaldehyde coming from the pressed-wood desks and carpet.*

The new materials should be kept in a well-ventilated room for a few weeks prior to putting them in the classroom with students. This allows the bulk of the formaldehyde and other gases to be released without causing ill effects. If furniture must be used right away, the classroom should be extremely well ventilated to avoid harmful effects.

Symptom #3: *Jenny is probably allergic to the pesticides or fertilizer that are being applied to her lawn every month.*

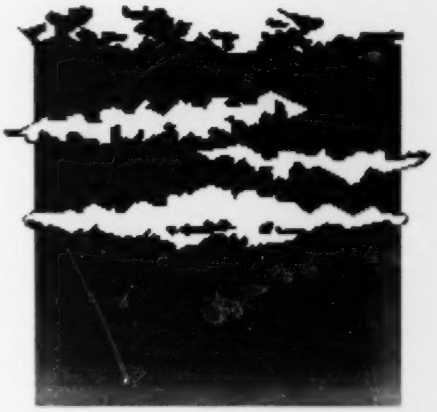
She should avoid playing on the lawn for about a week after the application. Her parents should consult Jenny's doctor about her symptoms. They should also check with the lawn company about using less toxic pesticides or doing less frequent applications.

Symptom #4: *Carbon monoxide was probably poisoning the family.*

If the firefighter pinpointed a source of carbon monoxide, it should be fixed immediately. Possible sources include gas appliances, gas or kerosene space heaters, gas hot water heaters, furnaces, fireplaces, and cars left running in attached garages. If the source could not be detected, the family should have all their appliances inspected for malfunction. The family should consider installing carbon monoxide detectors by the bedrooms.

The Air We Breathe

This section covers how and why pollutants get into the air, the importance of detecting and fixing those sources, and what people know about indoor air pollution.

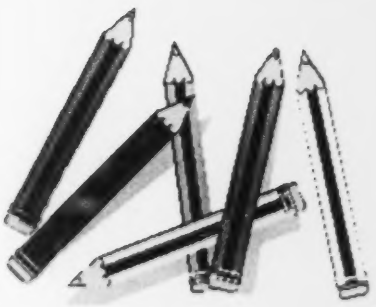


Suggested Activities:

The Importance of Detecting the Invisible
Find the Odor
Indoor Air Quality Survey

Vocabulary:

carbon monoxide, concentration, data, emissions, formaldehyde, hypothesis, monitoring, nitrogen oxide, particulates, pesticides, pollutants, radon, respiration, ventilation



The Air We Breathe

Pollutants from factories, cars, buses, and even lawn mowers can get into the outside air. But pollutants can get into the air inside, too. Simple things like cooking and heating and cooling our homes can pollute the air we breathe inside our home. Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems.

Why is indoor air pollution such a concern all of a sudden?
For many years houses have been built to be more air tight to conserve energy spent on heating and cooling, as well as to limit the amount of outside air coming in. Unfortunately, this practice also limits the amount of polluted air that escapes, which can cause pollutants to build up to unhealthy levels in the home.

However, lack of fresh air is only part of the problem. Many products in our homes today, things that we take for granted in our lives, are actually potential sources of pollutants. Cleaning products, personal hygiene and grooming products (hair spray, for example), pesticides, carpets, and pressed-wood furniture are just a few common household items that can create a problem.

Why aren't more people worried about indoor air pollution?
As we learned in the previous section, it is hard to tell when someone is feeling ill due to an indoor air quality problem. Many of the symptoms can be mistaken for a cold or the flu. Another factor is that many pollutants cannot be seen, smelled, or tasted. Radon,carbon monoxide, and nitrogen oxide are three hazardous indoor air pollutants that cannot be detected with the senses.

If we can't see the pollutants, then how do we know if there are any?
While most homes won't need an investor to come out and determine what the problem is,. the only way to know exactly what is in your air is to hire someone to test the air in your home with a monitoring device. Testing is time-consuming and expensive and may not tell you anything. For example, if a pollutant is present only at a certain time of day (or certain days of the month), the testing equipment must be set up during that time, or you may not know what is wrong. Testing is often done to confirm a hypothesis rather than to formulate one. You can purchase a radon test kit and a carbon monoxide detector relatively inexpensively and do the test on your own.

Indoor air quality investigators look at many different pieces of information to uncover the source of a problem. They might consider the design of the building, the materials used in its construction, the type of furniture, recent activities (for example, renovation or remodeling) occurring in the building, the symptoms, who is affected, and when and where in the building they are affected. By piecing together all of the pieces of the puzzle, investigators can form a complete picture of the problem and then go look for it.

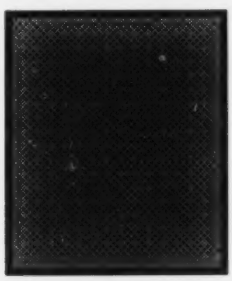
Is there any way to improve quality of the air?
Three methods reduce the amounts of pollutants in indoor air. They are listed in order of effectiveness:

1) Removing the source or controlling the emissions. Prevention is the key.
2) Increasing the amount of air flowing through the area (ventilation).
3) Using certain air cleaners (which filter out pollutants) that do not cause indoor air quality problems themselves.

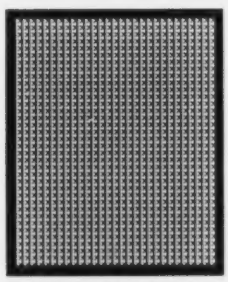
Should air cleaners be used?
Air cleaning alone cannot adequately remove all of the pollutants typically found in indoor air, but they may reduce the health effects from some particles. Many factors need to be considered in determining whether to use an air cleaner in your home. Do not confuse air cleaners with air fresheners. Air cleaners remove some pollutants from the air; air fresheners release a scent into the air to mask an odor. Air fresheners do not solve indoor air quality problems.

Some air cleaners, under the right conditions, can effectively remove certain fine particles (for example, tobacco smoke). These invisible particles are of concern because they can be inhaled deeply into the lungs where they cause the most damage. No one knows whether air cleaners can reduce the allergic reactions produced by large particles such as pollen, house dust allergens, mold, or animal dander. Most of these particles are found where they settle on surfaces in the home, rather than in the air. They cannot be removed by an air cleaner unless disturbed and resuspended (put back) in the air. The majority of air cleaners will not remove gaseous pollutants, such as radon, or reduce their associated health effects.

Most furnaces are equipped with a mechanical filter, a simple type of air cleaner. Mechanical filters come in two shapes, flat or pleated. Flat filters usually consist of many coarse fibers woven together and coated with a sticky substance to which the particles adhere.



Flat Filter



Pleated Filter

Pleated Filter
(cross-section)

These fibers are usually efficient at collecting large particles, but remove only a small percentage of finer particles. Pleated filters use smaller, more tightly packed fibers without reducing the amount of air flowing through them. Pleated filters are generally more efficient at capturing smaller-sized particles than flat filters.

Other types of filters include electronic air cleaners, ion generators, and "hybrids." Electronic air cleaners trap charged particles using an electrical field. Ion generators act by charging the articles in a room. The charged particles are then attracted to walls, floors, draperies, or a charged collector. "Hybrids" contain two or more of the cleaning devices mentioned above.

A filter's effectiveness at cleaning the air depends on how many particles the filter collects and how much air passes through it each minute. A filter may be efficient enough to remove most of the pollutants, but if less air moves through it, it may take a long time to clean the whole room. If there is not enough air flowing through the filter, pollutants may be released back into the air faster than they are taken out. For any filter to operate efficiently it needs to be cleaned or replaced monthly or according to the manufacturer's instructions.

Prevention is the best method for reducing pollutants in indoor air. The next few sections go over the major indoor air pollutants, their sources, and simple precautions students and their families can take to avoid indoor air quality problems.

Importance of Detecting the Invisible

Purpose:
For students to be able to detect invisible pollutants indoors

Objective:
Students will learn the importance of being able to detect invisible pollutants indoors. Students will explore a variety of ways to discover pollutants based on indirect evidence.

Time Needed:
30 to 40 minutes

Skill Building:
Assertiveness

Materials:
Clay
Pins
Toothpicks
Magnets
Different small objects (try to pick common classroom or household objects) (e.g. chalk, paper clips, and rubber bands)

What to Do:

Before Class:

1. Place objects inside clay balls.

When Class Begins:

1. Ask students where they spend most of their time. Help them to estimate the amount of time they spend at home, at school, in the car or on the bus, outdoors, and other places. Tally up how much time is spent indoors.
2. Discuss the importance of ensuring that the places where the students spend most of their time are free of pollutants that could make them sick. Ask students if they know of any pollutants in their homes that could make them sick. If necessary, prompt students by suggesting pollutants and their sources.

3. Ask students how they would know if pollutants were in the air at home or school. Can pollutants be seen or smelled? Discuss the fact that only some indoor air pollutants are visible or smelly enough to detect easily at certain concentrations.
4. Explain that many pollutants are invisible to the senses.
5. Discuss the experiment. Pass out the handouts. Explain that within each clay ball is a common classroom or household object and they will now try to determine what it is. The students will use the tools available to them to make observations about the object and to guess at the object's shape. Explain that air quality investigators use whatever tools they can to determine what pollutants are in a room.
6. First, have students draw what they think is inside the clay ball. Tell them that they are making a prediction.
7. Next, students can insert toothpicks, pins, magnets and other objects into the clay balls to discover the unknown object's identity. Have them write down their observations.
8. After testing each object, have the students draw a new diagram of the unknown object based on their observations so far.
9. When the last round is complete, have the students draw a final picture of what they believe is in the clay. Then have the students take the unknown object out of the clay.
10. Have students compare their predictions and the object itself to see how close they came. How close were they? Why were some predictions more accurate than others? What else could they have used to determine what was inside the clay ball?
11. Explain that when air quality investigations are conducted, sometimes the pollutant source cannot be found on the first try. Investigators often have to use different testing methods to arrive at a solution. Discuss the importance of having specialized equipment (e.g. radon test kit and carbon monoxide detector) that can help in the investigations.

Importance of Detecting the Invisible Worksheet

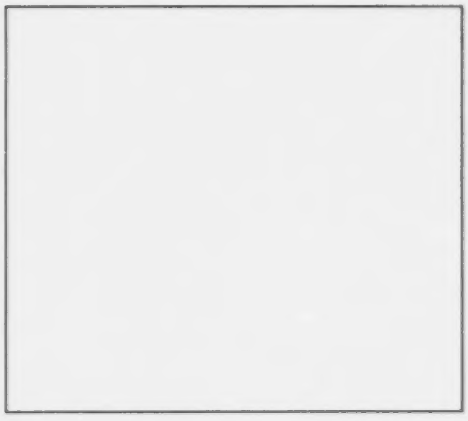
Prediction:

What does the hidden object look like? Try to draw it in the box above.

Observations:

Object	Observations	What's Inside
Toothpick		
Pins		
Magnet		
Other		

Draw the Hidden Object After Each Observation



Find the Odor

Purpose:

To learn the importance of monitoring air pollution sources

Objective:

Students will use their sense of smell to detect and recognize odors introduced into the class room atmosphere.

Time Needed:

30 to 40 minutes

Skill Building:

Recognition

Materials:

Six shallow plastic containers with lids
Vanilla extract
Nail polish remover with a strong odor or vinegar
Food coloring (blue, red, and yellow)
Chalkboard with colored chalk or an easel with colored markers

What to Do:

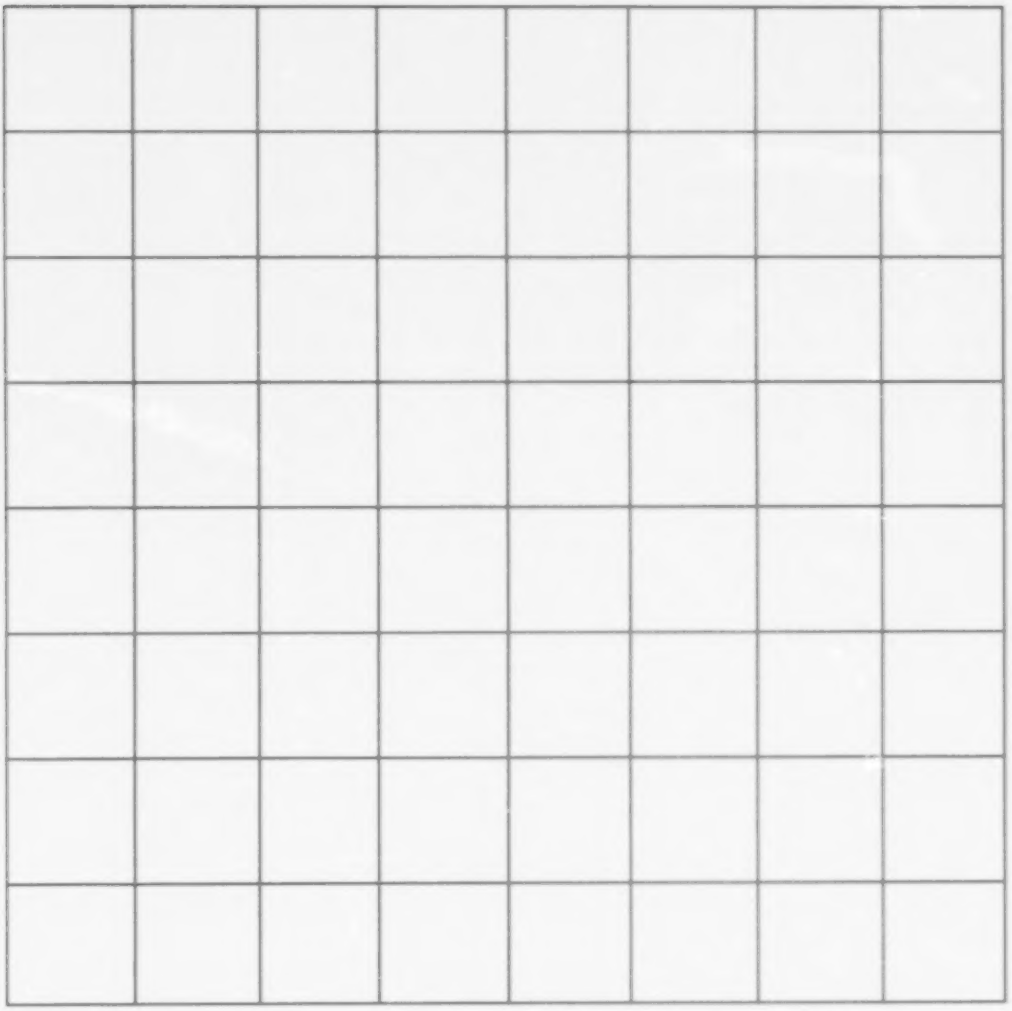
Before Class:

1. Mix food coloring together with water until the color resembles the vanilla extract. In another container, mix food coloring and water to resemble the nail polish remover (if you are using white vinegar, just water should be okay).
2. Put just enough vanilla extract in one of the container lids to cover the lid's surface.
3. Put equal amounts of nail polish remover and the two look-alike liquids in the remaining container lids. There should be one lid with vanilla, one with nail polish remover, and four with look-alike, nonodorous liquids.
4. Place the lids around the room and cover them by inverting the containers over them.
5. On the chalkboard or easel, draw two maps (with one color) of the classroom, one for charting time and the other for charting intensity.
6. Make copies of the Find the Odor Worksheet for each student.

When Class Begins:

1. Explain how determining what and where indoor air pollutants come from (monitoring) is an important part of protecting people. Some pollutants can be seen or smelled, but many aren't detectable by our senses. Pollutants can be detected by different kinds of monitoring devices (tools).
2. Explain that because monitoring tools are expensive and take longer to use than you have in class, the students are going to use their noses to detect and identify chemicals in the air. When you breathe, your nose acts like a monitoring tool with special cells in the back of the nose that allow you to identify some chemicals in the air. Instruct students to use their noses like scientists would use a monitoring device to detect and estimate the strength of an odor and to determine the source of that odor.
2. Explain that they will need to map the classroom to chart the results of the experiment. Hand out the Find the Odor Worksheets. Fill in the maps to show the location of each odor. You will fill in the maps on the chalkboard as each student fills in his or her own worksheet. Be sure the students understand where they are on the map.
4. When the maps are complete, briefly describe the experiment. The idea is to record when they first smell an odor and to measure how strong it is at various times. Go over the time and intensity measurements and make sure everyone understands how to fill out his or her worksheet. Plan to take your time on this part.
5. Remove the covers from the sources throughout the room containing the liquids. Leave the lids uncovered for two minutes. Announce the time every 30 seconds (for example, "A" on the worksheet would be T+30 seconds; "B" would be T+60 seconds, and so on). Remind students to find their place on their worksheet map and fill in the letter (time) and number (intensity) the FIRST TIME they smell an odor. If they detect more than one odor, they should fill in the letter (time) and number (intensity) the first time they smell EACH odor, have them distinguish the odors by placing an asterisk next to one of them. At each time they should record the intensity of the odor (e.g., if it is getting stronger).
6. At the end of two minutes, cover all sources again.
7. Call on students in different parts of the room. Try to have all students participate. Have each, in turn, come forward and mark their location, in colored chalk, on each of the maps on the board with the time and intensity information they have recorded on their worksheet.
8. Lead a student discussion of the results of the experiment. Ask why some students recorded stronger odors sooner than others. Did the odor move in one direction more than another? If so, what does that suggest about the way pollutants move in the air? Did anyone detect more than one odor? Where did the odor(s) come from? The students' answers should point you to the real sources. If not, be prepared to point out the real sources and explain how scientists might use additional trials or put out more monitors to be sure the results are accurate.
9. Describe the importance of being able to determine where pollutants are coming from. Give some examples. Locating pollutants makes it possible for the pollutants to be removed.

Find the Odor Worksheet



Back of Classroom

TIME

A = _____

B = _____

C = _____

D = _____

INTENSITY

1 = No odor detected at all

2 = Begin to smell the odor

3 = Odor is strong

4 = Odor is very strong

Indoor Air Quality Survey

Purpose:

To give students an idea of what people know about indoor air quality

Objective:

Students will learn data collection and tabulation skills and be able to interpret the class's results to get an idea of what people know about indoor air quality.

Note: This activity should be completed before the Room-By-Room activity to obtain a more accurate idea of what family members know about indoor air quality.

Time Needed:

1 evening to complete survey
30 to 40 minutes for classroom instruction and discussion

Skill Building:

Communication

Materials:

Clipboards (If you do not have clipboards, use a notebook with a paper clip)
Pencils
Graph paper
Chalkboard or easel
Colored chalk or markers

What To Do:

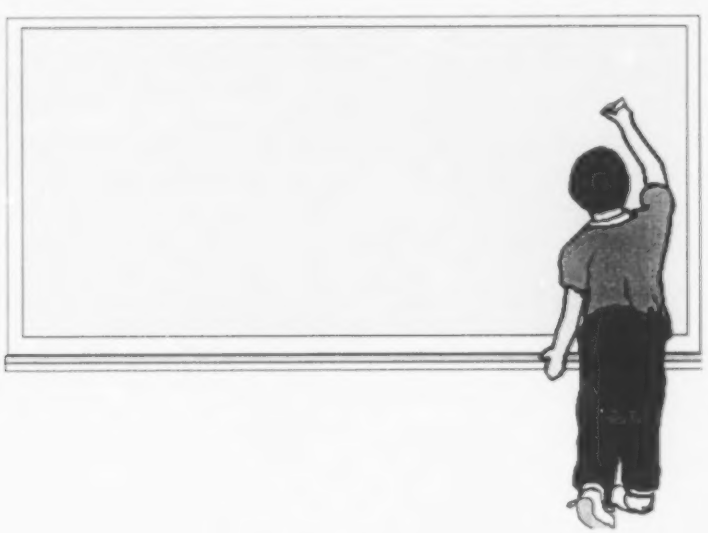
Before Class:

1. Make enough copies of the survey so each student gets five copies.
2. Prepare clipboards (or notebook) by attaching pencils, and putting five survey sheets on each clipboard (or notebook).
3. Make copies of the Indoor Air Quality Survey Tally sheet and Bar Graph for each student.

Indoor Air Quality Survey (Continued)

When Class Begins:

1. Explain the activity to the students. They will be conducting a survey (homework) of five family members or neighbors to find out how much they know about indoor air quality. Students should have family members help them with the survey. They should not survey strangers. The survey can either be conducted by phone or in person. Students can either ask the questions and fill out the answers themselves, or students can give the questionnaires to the subject and have them fill it out. Students should thank the people surveyed when they are finished.
2. Go over the survey questions with the students, make sure they understand each question and how to fill out the survey form.
3. When all the surveys have been completed, help the students tally their results. Using the tally sheet and the table, have them record the number of "Yes" and "No" answers for each question.
4. Create a table of the totals for the entire class for each question.
5. Explain the bar graph and how to fill it out. Help students as necessary.
6. Create a bar graph of the totals for the entire class for each question.
7. Discuss the results with the students. Which survey questions got the most "Yes" and most "No" answers? What does that mean? Does the survey show that people know a lot about indoor air quality? How do the individual results compare to the group results?



Indoor Air Quality Survey Sheet

Person Interviewed: _____

Relationship: _____

Directions:

Please answer the questions below by circling either YES or NO.

DO YOU THINK...

1. The air in your home can be hazardous to your health? YES NO
2. Your home should be tested for radon? YES NO
3. You can always see or smell indoor air pollutants? YES NO
4. Simple acts of cooking and bathing can cause indoor air quality problems? YES NO
5. Keeping your house clean can reduce the risk of developing an indoor air quality problem? YES NO
6. Smoking is only harmful to the person who smokes? YES NO
7. Proper furnace filter maintenance can reduce the risk of developing an indoor air quality problem? YES NO

Indoor Air Quality Survey Tally Sheet and Bar Graph

Tally Your Data:

Mark the total number of YES's and NO's for each question.

Question	YES	NO
Question 1		
Question 2		
Question 3		
Question 4		
Question 5		
Question 6		
Question 7		

Bar Graph:

Using the table above, fill in the bar graph for each question.

5							
4							
3							
2							
1							
	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7

Air Quality in Schools and Classrooms

This section covers the importance of good indoor air quality in schools and classrooms and the things teachers and students can do to improve air quality in their classrooms.

Suggested Activity:

How Safe Is Your Classroom?
Classroom Air Quality Checklist

Vocabulary:

allergic reaction, biological contaminants, humidity, organic chemicals, pollution, temperature, ventilation

Air Quality in Schools

There are more than 110,000 schools in the United States. Approximately 51 million people (nearly 1 in 5 Americans) occupy school buildings each school day. Many schools are overcrowded; approximately one-third of the nation's schools contain two-thirds of the school population. In February 1995, the U.S. Government Accounting Office released a report based on a survey indicating that more than half of our schools have problems that contribute to poor indoor air quality.

What are the consequences of poor air quality in schools?
Good air quality is an important component of a healthy indoor environment. It can help schools reach their primary goal: educating the students. By not responding promptly and effectively to indoor air quality problems, the following health, cost, and educational consequences could occur:

- Increased long- and short-term health problems for students and staff
- Spread of airborne infectious diseases
- Degraded student learning environment, which affects comfort and attendance
- Reduced productivity of teachers and staff from discomfort, sickness, or absenteeism
- Deterioration of the school building and equipment, which increases the risk that portions of the school will need to be closed
- Strained relationships between school administrators, staff, and parents
- Negative publicity for the school and its administrators
- Potential liability problems

Children are especially susceptible to air pollution. The same concentration of pollutants can affect children more than adults because children breathe a greater volume of air relative to their body weight. For this and the above reasons, air quality in schools is of particular concern.

Why do schools present a unique air quality situation?

Unlike other buildings, managing schools combines the responsibility for public funds and child safety. These issues can generate strong reactions from concerned parents and the general community. Schools also have some unique problems:

- School occupants are close together; the typical school has approximately four times as many occupants as an office building of the same amount of floor space.
- Budgets are tight and maintenance often receives the largest cut during budget reductions.
- A variety of pollutant sources are present, including art and science supplies, industrial and vocational art rooms, and appliances in home economic classes.
- Schools frequently have more than one heating, ventilating, air-conditioning system. As schools add space, the operation and maintenance of each addition is often different, placing an added strain on maintenance staff.
- Schools sometimes use rooms, portable classrooms, or buildings that were not originally designed for education.

What is the *Indoor Air Quality Tools for Schools Action Kit*?

School staff perform many simple, preventative measures to help ensure good air quality in the school. To provide school administrators and staff with guidance on how they can improve indoor air quality in their school, EPA developed the *Indoor Air Quality Tools for Schools Action Kit.* The easy-to-use kit shows schools how to carry out a practical plan of action at little or no cost using common-sense activities and in-house staff. The kit is used by maintenance personnel, administrators, teachers, health personnel, and others whose daily decisions and activities affect the quality of the air within the school. *Indoor Air Quality Tools for Schools Action Kit* provides simple-to-follow checklists, background information, sample memos and policies, a recommended Indoor Air Quality Management Plan, and a unique Indoor Air Quality Problem Solving Wheel to assist staff in preventing and resolving indoor air quality problems. For information on how to obtain *Indoor Air Quality Tools for Schools Action Kit*, call IAQ INFO at (800) 438-4318.

How Safe is Your Classroom?

Purpose:

To have students use their knowledge of indoor air quality in the home and adapt it to the classroom

Objective:

Students will learn about the importance of good indoor air quality in the classroom, the costs of bad indoor air quality, sources of indoor air pollutants, and actions that they can do to re duce or prevent indoor air pollution in their classroom.

Time Needed: 40 to 45 minutes

Skill-building: Using knowledge

Materials: Classroom Air Quality Checklist (handout)
Tissue paper
Maintenance request forms (if applicable)
Basic cleaning supplies

What to Do:

Before Class:

1. Be familiar with the potential pollutants in your classroom. Make a list for your reference.
2. Copy the Classroom Air Quality Checklist to hand out to students or make it into an overhead.
3. Obtain the books listed in #7 below, if applicable.

When Class Begins:

1. Explain to students the importance of good air quality in your classroom and why schools present a unique indoor air quality situation.
2. Ask children to use their knowledge of sources of indoor air pollutants in the home to point out possible sources of indoor air pollutants in the classroom. Make a list of all the sources they identify on the chalkboard.
3. Using the Classroom Air Quality Checklist, instruct students to go around the room and see what other sources are present. Then discuss ways that the students can help improve the air quality.
4. For items that the custodial staff will need to take care of, have the students write a letter or fill out a request form for the work.

5. If appropriate, enlist the students' help in cleaning up the room. Develop a list of chores for the students and assign one to each child.
6. If you use arts and crafts supplies, have the students write to the Art and Craft Materials Institute and the Center for Safety in the Arts for lists of safe art supplies. The addresses are included in the Supporting Materials section at the back of this guide.
7. If you use science supplies, *School Science Laboratories: A Guide To Some Hazardous Substances* and *Manual of Safety & Health Hazards In The School Science Laboratory* are good guidance documents. Information on how to obtain them is in the Supporting Materials section of this guide.
8. The number of potential sources is overwhelming. Stress that with proper maintenance and handling, most of the substances will never be a problem. Even without proper handling, most of the substances would not be a large problem. Students generally do not use extremely harmful substances. The purpose of this exercise is to teach students how to prevent problems from occurring, not just in this class but in all of their classes throughout their school years.

Teachers

play a strong role in indoor air quality because their decisions and activities can affect the sources of pollutants and levels of ventilation within their room. Some teachers, such as art, science, vocational and industrial arts, and home economics teachers, manage unique pollutant sources and ventilation equipment. Students contribute to classroom air quality during many classroom activities and through cleaning up after these activities.

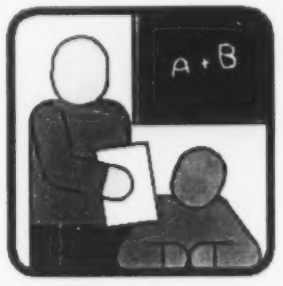
The following list gives some guidelines for improving the quality of the air in your classroom:

- Regularly and thoroughly clean the classroom.
- Limit the use of pesticides.
- Maintain a comfortable temperature and humidity.
- Keep animals caged. Clean the cages regularly. Use alternatives to animals, if possible.
- Identify students with allergies and take appropriate precautions.
- Fill drain traps (in floor drains, sinks, toilets) once a week, if they are not being used, to prevent the drains from drying out and allowing sewer gases into the room.
- Attend to leaks and spills promptly.
- Ensure proper ventilation (especially keeping the unit ventilators in good working condition and not using them as another surface to store items on).
- Use local exhaust fans and fume hoods properly.
- Use and store art and science supplies properly.
- Use less toxic science and art and craft materials.

Teachers usually have control over most of the list. If you don't have direct control over an item, report it as soon as possible to the appropriate school personnel.

By making students aware of potential air quality problems, and getting them involved in the prevention of problems, teachers can further improve their classroom air quality.

Note for Teachers: Much of this activity is drawn from the Teacher's Checklist in EPA's *Indoor Air Quality Tools for Schools Action Kit.* If your school is using this kit, this activity is an excellent tie-in.



Classroom Air Quality Checklist

Assess the air quality of your classroom by answering "Yes" or "No" for each question. Solutions are listed below the questions.

Classroom Cleanliness:

- Is the classroom clean and dust free? ❑ Yes ❑ No
  - Make sure the classroom is dusted and vacuumed thoroughly and regularly.
  - Make sure trash is removed daily.
  - Look for signs of pests (for example, roaches, mouse droppings).
- Are there any spills on the carpet or unit ventilator? ❑ Yes ❑ No
  - Contact custodial staff immediately if liquid spills on carpets or into the unit ventilator.
  - Let custodial staff know about any previous, unreported spills on carpets or in unit ventilators because these spills can affect current indoor air quality.

Animals in the Classroom:

- Does your class keep animals in the room? ❑ Yes ❑ No
  - Keep animals in cages as much as possible.
  - Clean the cages regularly.
  - Keep cages away from ventilation system vents and away from students with allergies.

Drain Traps:

- Does your classroom have any floor drain traps? Sinks? Toilets? ❑ Yes ❑ No
  - Pour approximately 1 quart of water down floor drains once a week.
  - Pour approximately 2 cups of water down sink drains once a week.
  - If not used regularly, flush toilets once a week.

Moisture in the Classroom:

- Do cold surfaces (for example, windows, window sills and frames, pipes, walls) in your classroom have water droplets or "fog" on them? ❑ Yes ❑ No
  - Contact maintenance staff; your room may be too humid.

- Are there any signs of leaks (for example, water around sinks, discolored ceiling tiles or walls)? ❑ Yes ❑ No
  - Contact the custodial staff and have the leaks fixed immediately.
  - Have water-damaged ceiling tiles replaced if you can.

Temperature:

- Is your classroom ever too hot or cold? ❑ Yes ❑ No
  - See the ventilation section below. If these suggestions don't help, contact the custodial staff.
- Does sunlight shine on the students at certain times of the day? ❑ Yes ❑ No
  - If your windows have blinds or shades, pull them down when necessary.

Ventilation:

- Does your room have unit ventilators (usually located below windows, with vents on top and on the bottom of the front panel)? ❑ Yes ❑ No
  - Unit ventilators provide classrooms with fresh air. The vents should not be blocked by anything. Papers, books, or other objects should not be placed on top of or directly in front of the unit ventilator.
- Locate the air supply and air return vents (if any) in your classroom. Air supply vents bring air into the classroom; air return vents take air out of the classroom. Are the vents blocked? ❑ Yes ❑ No
  - Make sure nothing blocks any of these vents
  - Make sure air is coming out of/going back into these vents. Hold a piece of tissue paper near the vents. Air supply vents will make the paper flutter away from the vent. Air return vents will suck the tissue paper closer to the vent.
- Do the windows open and close? ❑ Yes ❑ No
  - Windows can provide air to a classroom. Under certain conditions opening a window can correct an air quality problem (for example, ventilating a smell, cooling off a stuffy room in winter).

The following items are specific to certain activities and may not be in every classroom:

Fume Hoods and Exhaust Fans:

- Does your classroom have fume hood and fans (usually found in science classes)? ❑ Yes ❑ No
  - If your teacher has not already done so, have him/her explain why and how to use the fume hood and exhaust fan.
  - Make sure the hood works properly. Hold a piece of tissue paper under it. The paper should be drawn up toward the vent.

Science and/or Arts & Crafts Supplies:

- Help your teacher label all supplies with the date purchased and the date opened. Many products "go bad" over time.
- Read the labels carefully before each use, especially warnings about ventilation requirements.
- Make sure your supplies are stored according to manufacturer's recommendations.
- Make sure your supplies are stored away from the main classroom (if possible).
- Dispose of used materials according to manufacturer's instructions. Some supplies (such as certain chemicals) cannot be poured down the drain.
- Use the least amount of materials necessary to do the job. Don't be wasteful.
- Ask your teacher (or whoever orders the supplies) to purchase nontoxic art supplies. Safe art supplies are approved by the Art and Craft Materials Institute or the Center for Safety in the Arts. Lists of safe supplies can be obtained from these organizations.
- If your class uses science supplies, go over the following with your teacher:
  - uses of each product
  - precautions to take, special handling instructions
  - how to throw the product away (any restrictions, special packaging)
- Urge your teacher to use the least toxic alternative whenever possible.

Fact Sheet

Alternatives to Household Chemicals

What Are Household Chemicals?

Chemicals are common in many household products: personal care products, such as hair spray and spray deodorants; paints; hobby and home improvement supplies, such as glues and markers; aerosol sprays; cleaners and disinfectants; and automotive products. Household chemicals can irritate your eyes, nose and throat; cause headaches, visual disorders, and memory impairment; damage your central nervous system and kidneys; and possibly increase your risk of cancer.

Pesticides are another common source of household chemicals. Pesticides are used in and around the home to control insects, termites, rodents, fungi, and microbes. They are sold as sprays, powders, crystals, balls, and foggers. Pesticides are produced to be toxic to specific organisms, and consequently, can have both risks and benefits.

Biological contaminants are another household problem. Biological contaminants include living organisms, such as bacteria, mold, mildew, dust mites, and cockroaches, and parts or wastes of living organisms, such as animal dander, roach droppings, and pollen. Two conditions are required to support biological contaminants: nutrients and moisture.

We reach for household chemicals to control or prevent biological contaminants. We use harsh chemicals to clean bathrooms, carpets, and dishes, and to control mold, mildew, and bacteria. Using pesticides may seem quick and convenient ; however, these actions can result in a pollution cycle, with people using one pollutant to control another. In many cases, there are alternatives and safer solutions to household chemicals.

Why Choose Alternatives?

Choosing alternatives to household chemicals can break the pollution cycle in your home. Using fewer chemicals will make your home a healthier safer environment. The following table suggests alternatives and safer solutions for your home.

For More Information...

To learn more about hundreds of other alternatives and safer solutions to household chemicals, visit http://www.epa.gov/envirosense/new/contacts/newsltrs/shopping.html. This Web site is based on *A Consumers Guide to Safer Alternatives To Hazardous Household Products* and *Take Me Shopping* by Alicia Flynn and Rory Kessler, produced by the Santa Clara County Hazardous Waste Management Program, Santa Clara Valley Nonpoint Source Pollution Control Program, and the California Integrated Waste Management Board.

Alternatives to Household Chemicals

For This Use	Try This Alternative
Ant repellant	Red chili powder at entrance point
Chrome polish	Apple cider vinegar
Automatic dish detergent	1/2 cup baking soda + liquid detergent
Moth repellant	Cedar chips in cotton sachets
Flea repellant	Brewers yeast gradually added to your pet's diet (consult your veterinarian)
Rug/carpet cleaner	Baking soda
Toilet bowl cleaner	Baking soda + castile soap
Air freshener	Herbal bouquets, pure vanilla on a cotton ball, or cinnamon and cloves simmering on the stove
Window cleaner	2 tablespoons vinegar in 1 quart warm water
Mold and mildew remover	Bleach or equal parts vinegar and salt
Rusty bolt/nut remover	Carbonated beverages
Mosquito repellant	Citronella candles or oil
Car battery corrosion removal	Baking soda and water
Fertilizer	Composed yard clippings and organic waste from the kitchen (not meat or grease)
Perspiration stain remover	White vinegar + water
Pet odor removal	Cedar vinegar
Fly repellant	Well-watered bowl of basil
Roach repellant	Chopped bay leaves and cucumber skins
Ink spot remover	Cold water +1 tablespoon cream of tartar + lemon juice
Water softener	1/4 cup vinegar
Slugs and snails repellant	Onion and marigold plants
Drain cleaner	1/2 cup each baking soda and vinegar, wait 2 minutes, add two quarts boiling water, repeat
Stain remover	Club soda, lemon juice, or salt
Oil stain remover	White chalk rubbed into stain before laundering
Insects on plants	Rub soapy water on leaves, then rinse
Linoleum cleaner	1 cup white vinegar + 2 gallons of water
Copper cleaner	Rub with lemon, rinse and dry.
Oven cleaner	2 tablespoons each liquid soap and borax + warm water

Fact Sheet

Asbestos

What Is Asbestos?

Asbestos is a mineral fiber that was used commonly in a variety of building construction materials for insulation and as a fire retardant.

Where Is It Found?

Most products made today do not contain asbestos. The U.S. Environmental Protection Agency (EPA) and the Consumer Product Safety Commission (CPSC) have banned several asbestos products, and manufacturers have voluntarily agreed to limit the use of others. Any products made that still contain asbestos are required to be clearly labeled. However, many types of building products and insulation materials made before the 1970s contain asbestos and are not labeled. These products include pipe and furnace insulation materials; asbestos and cement shingles, siding, and roofing; millboard; resilient floor tiles, the backing on vinyl sheet flooring and floor tile adhesives; soundproofing or decorative material; patching and joint compound; fireproof gloves and stove-top pads; and automobile brake pads and linings, clutch facings, and gaskets.

What Are the Potential Health Effects?

The most dangerous asbestos fibers are too small to be visible. They can become airborne when asbestos-containing materials are disturbed or during improper removal. Once they are inhaled, the fibers can remain and accumulate in the lungs. Breathing high levels of asbestos fibers can lead to an increased risk of lung cancer, mesothelioma (a cancer of the chest and abdominal linings), and asbestosis (irreversible lung scarring that can be fatal). The risk of lung cancer and mesothelioma increases with the number of fibers inhaled. The risk of lung cancer is also greater for people who smoke. Symptoms of these diseases do not show up until many years after exposure begins. Most people with asbestos-related diseases were exposed to elevated concentrations on the job.

What Can Be Done?

It is usually best to leave asbestos material that is in good condition alone. Material in good condition will not generally release asbestos fibers. Try to prevent the material from being damaged, disturbed, or touched.

Periodically inspect the material for damage or deterioration. Properly dispose of damaged or worn asbestos gloves, stove-top pads, or ironing board covers. Check with appropriate officials on how to properly handle and dispose of these materials.

The only way to tell if an object contains asbestos by looking at it, is if the material is labeled. Otherwise, have it sampled and analyzed by a qualified professional. Until you receive the results, treat the material as if it contains asbestos. Samples should be extracted only by qualified professionals. If improperly done, extracting samples can be more hazardous than leaving the material undisturbed.

If the asbestos material is more than slightly damaged, or if you are going to make changes in your home that might disturb it, professional repair or removal is needed. Repair usually means either covering or sealing the asbestos material. Covering involves placing a protective wrap over or around the material that contains asbestos to prevent the release of fibers. Sealing involves treating the material with a sealant that either binds the asbestos fibers together or coats the material so fibers are not released. Repair is usually cheaper than removal, but may make it more difficult to remove the asbestos later if the need arises.

Can I Do the Work Myself?

EPA recommends that when dealing with materials containing asbestos, whether it is to test, repair, or remove, that you hire an asbestos professional to do the work for you. Improper handling of asbestos material can create more of a hazard than if it is left undisturbed. If you need to take corrective measures, you should use a different contractor than the one who tested for asbestos to avoid a conflict of interest.

Before you hire an asbestos professional, ask potential contractors to document their completion of a federal or state-approved training program. Also, ask for references from previous clients to learn if they were satisfied. To guard against costly, hazardous, and unnecessary removals, know what services are available and what procedures and precautions are needed to do the job properly.

If you need repairs or removal, make sure the work area is clearly marked as hazardous. Keep household members and pets away from the area until the work is completed. Be sure that your contractor avoids spreading or tracking asbestos dust into other areas of the home. The work area should be properly sealed off from the rest of the house using plastic sheeting and duct tape. Also, the air conditioning and heating system should be turned off. Before asbestos removal, insist that the contractor apply a wetting agent to the asbestos material with a fine mist hand sprayer. Wet fibers do not float as easily as dry fibers and are easier to clean up. The contractor should use wet mops, rags, or sponges to clean up the area. HEPA (high efficiency particulate air) vacuum cleaners can also be used. All asbestos materials and disposable equipment and clothing should be placed in marked and sealed leakproof bags and disposed of properly.

For More Information . . .

For more information, read the booklet *Asbestos in Your Home*, prepared by the CPSC, the American Lung Association, and the EPA, and *The Inside Story*, prepared by the EPA and CPSC. Call the Indoor Air Quality Hotline at (800) 438-4318 to obtain a copy of either document and for additional information.

Fact Sheet

Asthma

What is Asthma?

According to the American Lung Association, asthma is the seventh-ranked chronic health condition in the United States and the leading chronic illness of children. It is a chronic inflammatory disease that makes airways (bronchial tubes) particularly sensitive to irritants. During an asthma attack, tightening of the smooth muscles around the bronchial tubes causes them to become inflamed, narrow inside, and produce excess mucus. This makes it difficult for air to pass in and out of the lungs and decreases the oxygen levels in the blood. A person suffering from an asthma attack has a sensation similar to drowning.

What Makes Someone Develop Asthma?

Some people are born with a predisposition toward developing asthma. However, what actually triggers the disease can vary from person to person. Common triggers include environmental tobacco smoke, air pollution, pollen, allergens from animals and insects, abrupt weather changes, biological contaminants such as mold, and viral infections.

Studies show that children whose parents smoke are twice as likely to develop asthma as children of nonsmoking parents. Also, children whose mothers smoked during pregnancy tend to be born with smaller airways, which greatly increases their chances of developing the disease.

How Can A Person Tell If They Suffer From Asthma?

Diagnosis is the first step in keeping the condition under control. Early warning signs include fatigue; coughing, even when the person does not have a cold; wheezing; difficulty breathing; tightness in the chest; runny nose; itchy throat; and a change in the thickness, amount , or color of mucus.

Anyone regularly exhibiting any of the symptoms should see a doctor or allergist as soon as possible. The earlier the disease is diagnosed, the earlier the condition can be controlled.

How Many People Suffer From Asthma?

An estimated 12.4 million Americans suffer from asthma; 4.2 million of whom are under the age of 18. Asthma is the leading chronic illness of children in the United States and the leading cause of school absenteeism due to chronic illness.

About 4,000 people die from asthma attacks each year, more than 30 percent of them children. Health care costs associated with asthma are estimated at $6.9 billion a year. When indirect costs such as lost productivity are added, the amount rises to $9.5 billion. The number of deaths due to asthma, the number of Americans diagnosed with asthma, and the health care costs of asthma continue to increase each year.

What Can Be Done to Prevent Asthma and to Avoid Asthma Episodes?

- Do not allow smoking indoors unless there is a room reserved for smokers that has a separate ventilation system to exhaust smoke outside. **Never** allow smoking around anyone with asthma.

- Try to keep humidity levels in the home between 30 and 50 percent. High humidity can promote the growth of biological agents that may trigger asthma episodes. Use exhaust fans or open windows in the kitchen or bathroom areas when cooking, using the dishwasher, or taking showers. Make sure that clothes dryers are vented to the outdoors and use a dehumidifier in the basement if necessary.

- Avoid using humidifiers. If you must use a humidifier clean it according to the manufacturer's instructions. Refill it daily with fresh water to prevent the growth of harmful microbes.

- Minimize exposure to combustion particles and gases that can cause breathing difficulties for people with asthma. Have combustion-powered furnaces, stoves, or heaters checked yearly to make sure they are operating properly. Change furnace filters according to the manufacturer's instructions, or every month or two during periods of use. Consider installing higher efficiency filters to reduce the number of particles in the air. Never use a gas stove to heat the home. Always use the exhaust fan when cooking on a gas stove.

- Keep the house clean to reduce allergens like microscopic dust mites, pollen and animal dander. Use an allergen-proof comforter and encase mattresses and box springs in vinyl covers. Wash bedding frequently in hot (130°F) water. Avoid furnishings that collect dust. Try to eliminate cockroaches. Try to keep pets out of the bedrooms of family members with asthma. Consider using a high efficiency vacuum filter or a vacuum system that is vented to the outside to clean the house. If possible, remove the carpeting, drapes, and all upholstered furniture from the bedrooms of those suffering from asthma.

For More Information . . .

Call EPA's Indoor Air Quality Hotline at (800) 438-4318 or the American Lung Association at (800) LUNG-USA.

Fact Sheet

Biological Contaminants

What Are Biological Contaminants?

Biological contaminants include living organisms, their parts, and their wastes. They not only cause poor indoor air quality, but some can also damage surfaces inside and outside the home. These contaminants can travel through the air and are often invisible. Common indoor biological contaminants include bacteria, molds, mildew, viruses, animal dander and saliva, house dust mites, cockroaches, and pollen. There are many sources of these pollutants:

- Bacteria are carried by people, animals, and soil and plant debris.
- Viruses are transmitted by people and animals.
- Pollen originate from plants.
- The protein in urine from rats and mice is a potent allergen. When it dries, it can become airborne.

Two conditions are necessary to support biological growth: nutrients and moisture. These conditions can be found in many locations, such as bathrooms, damp or flooded basements, wet appliances (humidifiers and air conditioners), and some carpets and furniture. Mold, mildew, and other biological contaminants can grow in contaminated central air handling systems. These systems can distribute the contaminants through the home.

What Are the Potential Health Effects?

Many health effects are associated with biological contaminants:

- Some biological contaminants may trigger allergic reactions, including hypersensitivity pneumonitis, allergic rhinitis, and some types of asthma. Allergic reactions occur only after repeated exposure to a specific biological allergen. However, that reaction may occur immediately upon re-exposure or after multiple exposures over time. As a result, people who have noticed only mild allergic reactions, or none at all, may suddenly find themselves very sensitive to particular allergens.

- Infectious diseases, such as influenza, measles, tuberculosis, and chicken pox, are transmitted through the air.

- Some molds and mildews can release disease-causing toxins. These toxins can damage a variety of organs and tissues in the body, including the liver, central nervous system, digestive tract, and immune system. Some diseases, like humidifier fever, can be traced to microorganisms that grow in home heating and cooling systems, although it is not certain whether the disease is an allergic reaction or a toxic response.

Symptoms of exposure to biological contaminants include sneezing, watery eyes, coughing, shortness of breath, dizziness, lethargy, fever, and digestive problems. Children, elderly people, and people with breathing problems, allergies, and lung diseases are particularly susceptible to disease-causing biological agents in the indoor air.

How Can I Reduce My Exposure?

You can reduce your exposure to biological contaminants in several ways:

- Install and use exhaust fans that are vented to the outdoors in kitchens and bathrooms. Vent clothes dryer air to the outdoors.
- Keep the relative humidity level of the house between 30 and 50 percent. Dry off wet surfaces and correct water problems.
- Thoroughly clean and dry water-damaged carpets and building materials (within 24 hours if possible) or consider removal and replacement.
- Reduce dust mites, pollen, animal dander, and other allergy-causing agents through regular cleaning.
- Ventilate the attic and crawl spaces to prevent moisture buildup.
- Take steps to minimize biological pollutants in basements. Regularly clean and disinfect any basement floor drain. If needed, use a dehumidifier to keep relative humidity levels between 30 and 50 percent.
- Maintain and clean all appliances that come in contact with water. Have a professional inspect and clean furnaces, heat pumps, central and wall air-conditioning units, and furnace-attached humidifiers. Change the filters on heating and cooling systems frequently, line up according to the manufacturer's directions.

For More Information . . .

To learn more about biological contaminants, read *Biological Pollutants in Your Home*. Contact the Indoor Air Quality Hotline at (800) 438-4318 or the Consumer Product Safety Commission (CPSC) at (800) 638-2772 for a free copy. If you need to report an unsafe consumer product or product-related health problem, call the CPSC. Operators are on duty Monday to Friday from 10:30 AM to 4:00 PM eastern time to take your calls.

Fact Sheet

Carbon Monoxide

What Is Carbon Monoxide?

Carbon monoxide is an odorless, colorless gas that interferes with the delivery of oxygen in the blood to the rest of the body. It is produced by the incomplete combustion of fuels.

What Are the Major Sources of Carbon Monoxide?

Carbon monoxide is produced as a result of incomplete burning of carbon-containing fuels including coal, wood, charcoal, natural gas, and fuel oil. It can be emitted by combustion sources such as unvented kerosene and gas space heaters, furnaces, woodstoves, gas stoves, fireplaces, water heaters, automobile exhaust from attached garages, and tobacco smoke. Problems can arise as a result of improper installation and maintenance or inadequate ventilation.

What Are the Potential Health Effects?

Carbon monoxide interferes with the distribution of oxygen in the blood to the rest of the body. Depending on the amount inhaled, this gas can impede coordination, worsen cardiovascular conditions, and produce fatigue, headache, weakness, confusion, disorientation, nausea, and dizziness. Very high levels can cause death.

The symptoms are sometimes confused with the flu or food poisoning. Fetuses, infants, the elderly, and people with heart and respiratory illnesses are at particularly high risk for the adverse health effects of carbon monoxide.

An estimated 1,000 people die each year as a result of carbon monoxide poisoning and thousands of others end up in hospital emergency rooms.

What Can I Do to Prevent Carbon Monoxide Poisoning?

- Ensure that appliances are properly adjusted and working according to manufacturer's instructions and local building codes.
- Obtain annual inspections for heating system, chimneys, and flues and have them cleaned by a qualified technician.
- Open flues when fireplaces are in use.
- Use the proper fuel in kerosene space heaters.
- Do not use ovens and gas ranges to heat your home.

- Do not burn charcoal inside a home, cabin, recreational vehicle, or camper.
- Make sure stoves and heaters are vented to the outside and that exhaust systems do not leak.
- Use unvented gas or kerosene space heaters only in well-ventilated rooms. Choose vented appliances whenever possible.
- Never leave a car or lawn mower engine running in a shed, garage, or in any enclosed space.
- Make sure your furnace has adequate intake of outside air.

Carbon monoxide detectors should meet Underwriters Laboratories, Inc., standards, have a long-term warranty, and be easily self-tested and reset to ensure proper functioning. For maximum effectiveness during sleeping hours, carbon monoxide detectors should be placed close to sleeping areas.

For More Information . . .

For a free copy of *The Inside Story*, call the Indoor Air Quality Hotline at (800) 438-4318. For a free copy of *The Senseless Killer*, call the Consumer Product Safety Commission (CPSC) at (800) 638-CPSC.

Fact Sheet

Combustion Appliances

What Are Combustion Appliances?

Combustion appliances burn fuels for heating, cooking, or decorative purposes. Examples include space heaters, ranges, ovens, stoves, furnaces, fireplaces, water heaters, and clothes dryers. Common fuels used by these appliances are natural or liquefied petroleum (LP) gas, fuel oil, kerosene, wood, or coal. These appliances are usually safe. However, under certain conditions, these appliances can produce combustion pollutants that can damage your health or even cause death.

What Are the Potential Health Effects?

Combustion pollutants are gases or particles that result from burning materials. The types and amounts of pollutants produced depend on the appliance; how well the appliance is installed, maintained, and vented; and the fuel it uses. Major combustion pollutants and the health effects of exposure include the following:

- **Carbon monoxide** interferes with the delivery of oxygen in the blood to the rest of the body. It can cause fatigue, headaches, dizziness, weakness, nausea, vomiting, increased chest pain in people with heart disease, confusion and disorientation, and, at high levels, death. According to Consumer Safety Product Commission (CPSC), more than 1,000 carbon monoxide deaths occur each year. Because the chemical is odorless and some of the symptoms are similar to common illnesses, the effects may not be recognized until it is too late. Those most at risk are the elderly, infants, fetuses, and people with anemia or with a history of heart or respiratory disease.

- **Nitrogen dioxide** is a colorless, odorless gas that can cause irritation of the respiratory tract, shortness of breath, and increased incidences of respiratory illness. Evidence from animal studies show that repeated exposures to elevated nitrogen dioxide levels may lead or contribute to the development of lung diseases such as emphysema. Children and individuals with asthma and other respiratory illnesses are at greater risk from exposure to nitrogen dioxide.

- **Particulates** can cause eye, nose, throat, and lung irritation. They can also increase respiratory problems, especially in people with preexisting medical conditions, such as cardiovascular illness and immune system diseases. Certain chemicals attached to particles may cause lung cancer if they are inhaled. The risk of lung cancer increases with the length and amount of exposure. The health effects from inhaling particles depend on many factors, including the chemical makeup and size of the particles.

- **Sulfur dioxide** irritates the eyes, nose, and the respiratory tract at low levels of exposure. At high levels, it causes the lung airways to narrow. This results in chest tightness, wheezing, or breathing problems.

Combustion always produces water vapor. Although water vapor is not usually considered to be a pollutant, it can act as one. Water vapor can cause high humidity and wet surfaces. These conditions encourage the growth of biological pollutants such as house dust mites, molds, and bacteria.

How Can I Reduce My Exposure?

- Take special precautions when operating unvented, fuel-burning space heaters. Follow the manufacturer's directions, especially instructions on the proper fuel and proper adjustments. While a space heater is in use, open a door from the room where the heater is located to the rest of the house and open a window slightly.

- Install and use exhaust fans with gas stoves and ranges and keep the burners properly adjusted. A persistent yellow-tipped flame is generally an indicator of maladjustment and increased pollutant emissions. Ask your gas company to adjust the burner so that it operates properly. If you purchase a new gas stove or range, consider buying one with pilotless ignition, so that a pilot light will not be burning continuously. Also, never use a gas stove to heat your home.

- Keep woodstove emissions to a minimum. Make certain that doors in old woodstoves fit tightly. Use aged or cured wood only and follow the manufacturer's directions for starting, stoking, and extinguishing the fire in woodstoves. Do not burn pressure-treated wood indoors. If you are purchasing a woodstove, choose a properly sized new stove that is certified as meeting EPA emission standards.

- Make certain the flue in your fireplace is open each time you use the fireplace.

- Have the central air handling system components, including furnaces, flues, and chimneys, inspected annually and promptly repair cracks or damaged parts. Blocked, leaking, or damaged chimneys or flues release harmful combustion gases and particles, and can release fatal concentrations of carbon monoxide. Strictly follow all service and maintenance procedures recommended by the manufacturer, including those that tell you how frequently to change the filter. If the manufacturer's instructions are unavailable, change the filters once every month or two during periods of use.

- If you suspect that combustion pollutants are causing adverse health effects, consider turning off any combustion appliances, and contact the appliance service company or fuel company to inspect and, if needed, adjust the appliance. See a doctor to determine if symptoms may be caused by the combustion pollutants.

For More Information . . .

To learn more about combustion pollutants, read the booklet *What You Should Know About Combustion Appliances and Indoor Air Pollution*. To obtain a copy call the Consumer Product Safety Commission (CPSC) at (800) 638-CPSC, or EPA's Indoor Air Quality Hotline at (800) 438-4318.

Fact Sheet

Environmental Tobacco Smoke

What Is Environmental Tobacco Smoke?

Environmental tobacco smoke (ETS) is a mixture of particles that are emitted from the burning end of a cigarette, pipe, or cigar and smoke exhaled by the smoker. Smoke can contain any of more than 4,000 compounds, including carbon monoxide and formaldehyde. More than 40 of the compounds are known to cause cancer in humans or animals, and many of them are strong irritants. ETS is often referred to as "secondhand smoke" and exposure to ETS is often called "passive smoking."

What Are the Potential Health Effects?

Secondhand smoke has been classified as a Group A carcinogen by the U.S. Environmental Protection Agency (EPA), a rating used only for substances proven to cause cancer in humans. A 1992 EPA study indicates that each year approximately 3,000 lung cancer deaths in nonsmoking adults can be attributed to ETS. Exposure to secondhand smoke also causes eye, nose, and throat irritation. It may affect the cardiovascular system, and some studies have linked exposure to secondhand smoke with the onset of chest pain. ETS is an even greater health threat to people who already have heart and lung illnesses.

Infants and young children whose parents smoke in their presence are at increased risk of lower respiratory tract infections (pneumonia and bronchitis) and are more likely to have symptoms of respiratory irritation like coughing, wheezing, and excess phlegm. In children under 18 months of age, passive smoking causes between 150,000 and 300,000 lower respiratory tract infections, resulting in 7,500 to 15,000 hospitalizations each year, according to EPA estimates. These children may also have a build-up of fluid in the middle ear, which can lead to ear infections. Slightly reduced lung function may occur in older children who have been exposed to secondhand smoke.

Children with asthma especially are at high risk from ETS. EPA estimates that exposure to ETS increases the number of asthma episodes and the severity of symptoms in 200,000 to 1,000,000 children annually. Secondhand smoke may also cause thousands of non-asthmatic children to develop the disease each year.

How Can I Reduce My Exposure?

Do not allow smoking in your home, especially around children. Do not allow babysitters and others who work in your home to smoke in your home or near your children. If someone does smoke at home, increase ventilation in the area where smoking takes place.

Make sure that any outside group that assists in the care of children, including schools and daycare facilities, has a smoking policy in force that protects children from exposure to ETS.

If your workplace does not have a smoking policy that protects nonsmokers from exposure to ETS, try to implement one. See if your company will either ban smoking indoors or designate a separately ventilated smoking room that nonsmokers do not have to enter as part of their work responsibilities.

For More Information . . .

To find out more about environmental tobacco smoke and how to reduce exposure, order *Secondhand Smoke: What You Can Do About Secondhand Smoke as Parents, Decision-makers, and Building Occupants* and the *Respiratory Health Effects of Passive Smoking-Fact Sheet* from the Indoor Air Quality Hotline at (800) 438-4318. Contact the American Lung Association at (800) LUNG-USA.

Fact Sheet

Formaldehyde

What Is Formaldehyde?

Formaldehyde is a colorless, strong-smelling gas. It is widely used to manufacture building materials and numerous household products. Its most significant use in homes is as an adhesive resin in pressed wood products. There are two types of formaldehyde resins: urea formaldehyde (UF) and phenol formaldehyde (PF). Products made of urea formaldehyde can release formaldehyde gas. Products made of phenol formaldehyde generally emit lower levels of the gas.

Where Is It Found?

Formaldehyde is an important industrial chemical used to make other chemicals, building materials, and household products. It is used in glues, wood products, preservatives, permanent press fabrics, paper product coatings, and certain insulation materials. Building products made with formaldehyde resins can "off-gas" (emit) formaldehyde gas. These products include particle board used as subflooring or shelving, fiberboard in cabinets and furniture, plywood wall panels, and foamed-in-place urea-formaldehyde insulation. Some sources that previously contained formaldehyde are either no longer used or have been reformulated to contain less formaldehyde. Incomplete combustion, cigarette smoking, and burning wood, kerosene, and natural gas also release formaldehyde.

What Are the Potential Health Effects?

Formaldehyde is normally present at low levels, usually less than 0.06 parts per million (ppm), in both outdoor and indoor air. When present in the air at levels at or above 0.1 ppm, acute health effects can occur, including watery eyes; burning sensations in the eyes, nose, and throat; nausea; coughing; chest tightness; wheezing; skin rashes; and other irritations. Colds, flu, and allergies can cause symptoms similar symptoms. Formaldehyde affects people differently. Some people are very sensitive to formaldehyde, while others may have no noticeable reaction at the same level of exposure. Sensitive people can experience symptoms at levels below 0.1 ppm. The World Health Organization recommends that exposure not exceed 0.05 ppm.

Formaldehyde has caused cancer in laboratory animals and may cause cancer in humans. There is no known threshold level below which there is no threat of cancer. This risk depends on the amount and duration of exposure.

What Are the Solutions?

Exposure to formaldehyde may be decreased in the following ways:

- Purchasing pressed wood products labeled as low-emitting or products made from phenol formaldehyde, such as oriented strand board or softwood plywood
- Increasing ventilation after bringing new sources of formaldehyde into your home
- Using alternate products such as lumber, metal, or solid wood furniture
- Avoiding the use of foamed-in-place insulation containing formaldehyde, especially urea-formaldehyde foam insulation
- Enclosing unfinished pressed-wood surfaces of furniture, cabinets, or shelving with laminate or water-based sealant
- Washing durable-press fabrics before use
- Ensuring that combustion sources are properly adjusted
- Avoiding smoking indoors
- Maintaining moderate temperatures and low (30 to 50 percent) relative humidity levels

How Can I Measure Formaldehyde Levels?

Do-it-yourself formaldehyde measuring devices are available. The results should be interpreted with caution, however, because weather conditions, ventilation rates, and other factors can affect the results. Use such devices according to the instruction. In cases where the accuracy of results is critical, only trained professionals should measure formaldehyde because of the difficulty of obtaining good data and interpreting the results.

For More Information . . .

Call the EPA Toxic Substance Control Act Assistance Line at (202) 554-1404 or the Indoor Air Quality Hotline at (800) 438-4318 to find out more about formaldehyde.

Fact Sheet

Lead

What Is Lead?

Lead is a highly toxic metal that produces a range of adverse health effects particularly in young children.

Where Is It Found?

Humans can be exposed to lead in many ways: through deteriorating paint and dust, air, drinking water, food, and contaminated soil. Airborne lead enters the body when you breathe or swallow lead particles or dust. Lead can leach into drinking water from certain types of plumbing materials (lead pipes, copper pipes with lead solder, and brass faucets) and can be found on walls, woodwork, and the outside of your home in the form of lead-based paint. Lead can be deposited on floors, window sills, eating and playing surfaces, or in the dirt outside the home.

Approximately 64 million homes or 83 percent of the privately owned residences built before 1980 have lead-based paint somewhere in the building. Nearly one-fifth of these homes are occupied with children under the age of seven years old. Most paint made after 1978 contains no intentionally added lead, since it was banned from use on the interior and exterior of homes.

Even though leaded gasoline is seldom used today, high levels of lead found in soil can be attributed to past emissions.

Children can swallow harmful amounts of lead if they play in the dirt or in dusty areas (even indoors) and then put their fingers, clothes, or toys in their mouths or eat without washing their hands first.

What Are the Potential Health Effects?

Exposure to excessive levels of lead can cause brain damage; affect a child's growth; damage kidneys; impair hearing; cause vomiting, headaches, and appetite loss; and cause learning and behavioral problems. In adults, lead can increase blood pressure and cause digestive problems, kidney damage, nerve disorders, sleep problems, muscle and joint pain, and mood changes.

Fetuses, infants, and children are more vulnerable to lead exposure than adults since lead is more easily absorbed into growing bodies. Also, the tissues of small children are more sensitive to the damaging effects of lead.

Exposure to lead is estimated by measuring levels in the blood (micrograms per deciliter). According to the Centers for Disease Control (CDC), you should be concerned if your child has a blood lead level of 10 micrograms per deciliter or higher. The CDC recommends testing every child at their one-year checkup or at six months if the child is at risk of high-dose exposure.

How Can I Test to Determine If My Home Contains Lead-Based Paint?

The most accurate way to determine if your home has lead-based paint is to hire a professional to test the paint. Lead inspectors use special instruments to determine the content of lead in paint immediately. A risk assessor will take samples from several locations in your home and have them analyzed at a lab for lead content. If you are concerned about a specific area in your home and want to take a simple paint chip, dust, or soil sample yourself, you can mail the sample directly to a certified laboratory and have it analyzed. Taking a sample without an assessor is easy and may be less expensive, but it only tests the area where the paint, soil, or dust sample was taken. A house may contain several layers of paint from different periods, so one or two samples may not represent the entire residence.

EPA has not approved and does not recommend do-it-yourself lead test kits. These kits, which do not require lab analyzation, are not very accurate in determining the existence of lead paint. For more information, or to locate lead-based paint inspectors, risk assessors, and certified laboratories, call (800) 424-5323.

How Can I Reduce My Exposure?

- If your home has lead paint, do not try to remove the lead from your home yourself. Improper removal often makes the situation worse. Hire a qualified contractor to do the work. In some states, landlords may be required by law to remove lead-based paint from homes where children have been poisoned. Check with local health officials.
- Since lead can come from the solder or plumbing fixtures in your home, water from each faucet should be tested. Call the EPA Safe Drinking Water Hotline at (800) 426-4791 for information on laboratories certified to test for lead.
- Mop floors and wipe window ledges and other areas with a solution of powdered automatic dishwashing detergent. If available, tri-sodium phosphate detergent or lead-specific cleaning products can be used.
- Keep the areas where children like to play as clean and dust-free as possible.
- Keep children away from areas where paint is chipped or peeling. Stop children from chewing on window sills or other painted surfaces.
- Make sure everyone washes their hands before meals, naptime, and bedtime.
- If your child's bottle or pacifier falls on the floor, wash it before giving it back to your child.
- Wash toys, stuffed animals, and bedding regularly.
- Send children and pets to a relative's or neighbor's house if you plan to renovate your house. Infants, children, and pregnant women should not be in the home while renovations are under way.

- If you are pregnant, take as much care as possible to avoid exposing yourself to lead. Lead can pass through your body to your unborn baby and cause health problems.
- Do not let your children eat sand, dirt, or paint chips. Encourage your children to play in grassy areas of the yard or playground. Plant grass in areas where children play if possible. Make sure children remove and wipe their shoes and wash their hands whenever they come inside after playing outdoors.
- Try to make sure your children eat a balanced diet with plenty of foods that contain iron and calcium. A child who gets enough of these minerals will absorb less lead. Foods rich in iron include eggs, lean red meat, and beans, peas, and other legumes. Dairy products such as milk, cheese, and yogurt are also recommended for their high calcium content.
- Do not store food or drinks in containers made from crystal because some crystal contains lead.

What Is the Residential Lead-Based Paint Hazard Reduction Act?

The Residential Lead-Based Paint Hazard Reduction Act of 1992, known as Title X, requires that most home buyers and renters receive known information on lead-based paint hazards during sales and rentals of housing built before 1978. Sellers and landlords are required to provide a lead-based paint disclosure form and a federal pamphlet, entitled *Protect Your Family From Lead In Your Home*, to the buyer or renter before the sale or lease of certain property. Landlords are also required to disclose information regarding lead-based paint to preexisting tenants if the property was built prior to 1978. Congress passed Title X to protect families from exposure to lead by requiring disclosure for lead-based paint hazards in residential property. Title X became effective for all residential property built before 1978 on December 6, 1996.

For More Information . . .

National Lead Information Center at (800) 424-5323 for general information or to locate documents pertaining to Title X, the Residential Lead-Based Paint Hazard Reduction Act of 1992.

Fact Sheet

Pesticides

Where Are Pesticides Found?

Pesticides are widely used inside buildings to reduce many household pests, including those associated with indoor plants, pets, and wood and woolen products. They are also tracked in from the outdoors. Pesticides used in and around the home include products to control insects, termites, rodents, fungi, and microbes. They are sold as sprays, powders, crystals, balls, and foggers. Pesticides are produced specifically because they are toxic to certain organisms. Consequently, they have risks as well as benefits, and it is important to use them properly.

Surveys show that 75 percent of homes in the United States use at least one pesticide product indoors each year. Those most often used are insecticides and disinfectants. Studies suggest that 80 to 90 percent of most exposures to pesticides occur indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes. Pesticides can get into the air in homes from other sources, including contaminated soil or dust that floats or is tracked in from the outside, stored pesticide containers, and household surfaces that collect and then release fumes from the pesticides.

What Are the Potential Health Effects?

The health effects associated with pesticide exposure include irritation to the eyes, nose and throat; damage to the central nervous system and kidneys; and for some, an increased risk of cancer. Exposure to high levels of cyclodiene pesticides, usually due to misapplication, may cause headaches, dizziness, muscle twitching, weakness, tingling sensation, and nausea. Some believe these pesticides might cause long-term damage to the central nervous system and the liver; and can also affect vision and memory.

In 1990, the American Association of Poison Control Centers reported that some 79,000 children were involved in common household pesticide poisonings or exposures. In households with children, almost one-half stored at least one pesticide product within reach of the children.

How Can I Reduce My Exposure?

To reduce risks when you are using pesticides, take the following precautions:

- Buy only legally sold, EPA-registered pesticides.
- Reread the directions on the label each time you use the pesticide and follow the directions carefully. Use only the amount directed, under the conditions specified, and for the purpose listed.
- Use nonchemical methods of pest control when possible.

- Identify the pest and use a pesticide targeted for that pest.
- Ventilate the area during and well after pesticide use.
- Dispose of unused pesticides safely.
- Anyone considering the use of a pest control company should receive satisfactory answers to questions about the company's track record, insurance coverage, licenses, affiliation with professional pest control associations, and the proposed treatment.

For More Information . . .

If you have questions about pesticides or would like to obtain more information, call the EPA sponsored National Pesticide Telecommunication at (800) 858-PEST.

Fact Sheet

Radon

What Is Radon?

Radon is a naturally occurring, colorless, odorless, tasteless, radioactive gas produced by the breakdown of uranium in rocks and soil. It is the second leading cause of lung cancer in the United States.

Where Is It Found?

Radon comes from the soil surrounding and beneath the house, especially soil or rock that contains uranium, shale, phosphate, granite, and pitchblende. It typically moves up through the soil into the air above and then into your home through cracks in foundations and walls, openings around sump pumps and drains, and construction joints. The highest concentrations of radon can be found in the lowest levels of the home.

Radon may also be present in well water and can be released into the air in your home when water is used for showering and other household uses. The risk of radon entering homes through water is small compared with that of radon entering through the soil. Usually, radon is not a problem with large community water supplies, but private wells can contain high levels. On average radon in water contributes about 5 percent of the total indoor air concentration in homes served by wells.

Radon levels are measured in picocuries per liter (pCi/L) of air. The average indoor level is around 1.3 pCi/L. The average outside level is 0.4 pCi/L. Although there is no level at which radon is considered to be safe, EPA recommends reducing radon if indoor levels are at or above 4.0 pCi/L.

Is Radon Really a Problem?

Nearly 1 in 15 homes in the United States is estimated to have elevated radon levels. Elevated levels have been found in every state. While radon problems may be more common in some areas, any home may have a problem. In addition, the level of radon in a nearby home or building cannot be used to predict the level of radon in your home or building. Two adjacent houses may have very different radon levels. EPA recommends that all homes below the third floor be tested for radon and that all schools be tested. The test kit should be placed in the lowest occupied level in the home.

What Are the Potential Health Effects?

Radon gas decays into radioactive particles that can get trapped in your lungs when you breathe. As the particles break down further, they release small bursts of energy. This energy can damage lung tissue and lead to lung cancer over the course of a person's lifetime. Radon is estimated to be second only to smoking as a cause of lung cancer in the United States. An estimated 14,000 deaths each year can be attributed to excessive radon exposure. Radon **does not** cause any short-term health effects, such as shortness of breath, coughing, headaches, or fever.

A person's chance of getting lung cancer from radon depends mostly on the concentration of radon in his or her home, the amount of time spent in the home, and whether he or she is a smoker. Smokers have a higher risk of developing radon-induced lung cancer.

How Do I Test For Radon?

Testing for radon is easy and inexpensive. There are many kinds of low-cost , do-it-yourself radon test kits that you can order by mail or purchase from hardware stores or other retail outlets. Make sure that you purchase a test kit that has passed EPA's testing program or one that is state-certified. The National Safety Council also offers test kits that can be purchased by calling (800) SOS-RADON.

There are two tests for radon levels: short-term or long-term. Short-term tests remain in your home for 2 to 90 days, depending on the type of device. Because radon levels tend to vary from day to day and season to season, a short-term test is less likely than a long-term test to tell you your year-round average radon level. Long-term test devices remain in your home for more than 90 days. These tests give a more accurate picture of your year-round levels.

When using short-term tests, keep the doors and windows shut for 12 hours before starting the test and as much as possible while the testing is in progress. Place the test in the lowest lived-in level of the home (for instance, a basement if it is frequently used, otherwise the first floor). It should be placed in a room that is used regularly but **not** in the kitchen or bathroom. Kits should be placed at least 20 inches above the floor, away from drafts, high heat or humidity, and exterior walls.

If your short-term test results in a radon level greater than 4.0 pCi/L, follow up with either another short-term test or a long-term test. If you follow-up with a short-term test, average the results of the two. If that number is higher than the 4.0 pCi/L EPA-recommended action level, have your home fixed. Similarly, if a follow-up long-term test has results greater than 4.0 pCi/L, you should have your home fixed.

If you decide to have someone test your home for you, make sure they are an EPA-qualified radon tester. Call your state radon office for a list of these contractors.

Can Radon Problems Be Fixed?

Radon levels can easily be reduced in most homes. Repair costs vary from $500 to $2,500, depending on how your home was built and the extent of the radon problem. The average costs are about $1,200. You should use a contractor who has passed the EPA Radon Contractor Proficiency program to fix your home. As with the testors, call your state radon office for a list of qualified contractors.

A variety of methods are used to reduce radon in your home. In some cases, sealing cracks in floors and walls may help to reduce radon. In other cases, simple systems using pipes, and if necessary a fan, may be used to reduce radon. The pipes remove radon gas from below the concrete floor and the foundation before it can enter the home and direct the radon gas to the outside air where it is harmlessly dissipated. These "subslab depressurization" systems do not require major changes to your home. Similar systems can be installed in houses with crawl spaces. Your contractor can help you determine which method is right for your home.

Test your home after it has been fixed to be sure that radon levels have been reduced below 4.0 pCi/L. In addition, it's a good idea to retest your home every few years to be sure that the levels remain low.

For More Information . . .

To receive a free brochure and a test kit coupon, call the National Radon Hotline at (800) SOS-RADON. For more detailed information or if you have specific questions, call the National Safety Council's Air Quality Helpline at (800) 55-RADON.

Fact Sheet

Sick Building Syndrome

What Is Sick Building Syndrome?

Sick building syndrome is a situation in which occupants of a building experience acute health effects that seem to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone or may be widespread throughout the building.

Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures. Sometimes indoor air problems are a result of poor building design or occupant activities.

What Are the Symptoms of Sick Building Syndrome?

Building occupants complain of symptoms associated with acute discomfort. These symptoms include headaches, eye, nose, and throat irritation, a dry cough, dry or itchy skin, dizziness and nausea, difficulty in concentrating, fatigue, and sensitivity to odors. With sick building syndrome, no clinically defined disease or specific chemical or biological contaminant can be determined as the cause of the symptoms. Most of the people who are affected feel relief soon after leaving the building.

Sick building syndrome may also reduce worker productivity and increase absenteeism.

What Causes Sick Building Syndrome?

While specific causes of sick building syndrome remain unknown, the following have been cited as contributing factors to sick building syndrome. These elements may act in combination or may supplement other complaints such as inadequate temperature, humidity, or lighting.

- Chemical contaminants from outdoor sources: Outdoor air that enters a building can also be a source of indoor air pollution. Pollutants from motor vehicle exhausts, plumbing vents, and building exhausts (bathrooms and kitchens) can enter the building through poorly located air intake vents, windows, and other openings. Combustion byproducts can also enter a building from a nearby garage.

- Biological contaminants: Biological contaminants include pollen, bacteria, viruses, and molds. These contaminants can breed in stagnant water that has accumulated in humidifiers, drain pans, and ducts, or where water has collected on ceiling tiles, insulation, or carpet. Biological contaminants can cause fever, chills, cough, chest tightness, muscle aches, and allergic reactions. One indoor air bacterium, Legionella, has caused both Pontiac Fever and Legionnaire's Disease.

- Inadequate ventilation: In the 1970s, the oil embargo led building designers to make buildings more air tight, with less outdoor air ventilation, in order to improve energy efficiency. These reduced ventilation rates have often been found to be inadequate to maintain the health and comfort of building occupants.

- Chemical contaminants from indoor sources: Most indoor air pollution comes from sources inside the building. For example, adhesives, upholstery, carpeting, copy machines, manufactured wood products, cleaning agents and pesticides may emit volatile organic compounds including formaldehyde. Research shows that some volatile organic compounds can cause chronic and acute health effects at high concentrations and some are known carcinogens. Low to moderate levels of multiple volatile organic compounds may also produce acute reactions in some individuals. Environmental tobacco smoke and combustion products from stoves, fireplaces, and unvented space heaters can all put chemical contaminants into the air.

What Are the Solutions to Sick Building Syndrome?

Solutions to sick building syndrome problems usually include combinations of the following measures:

- Increasing the ventilation rates and air distribution is often a cost-effective means of reducing indoor pollution levels. At a minimum, heating and air conditioning systems should be designed to meet ventilation standards in local building codes. Make sure that the system is operated and maintained to ensure that the design ventilation rates are attained. If possible, the system should be operated to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62-1989. If there are strong pollutant sources, air may need to be vented directly to the outside. This method is especially recommended to remove pollutants that accumulate in specific areas such as restrooms, copy rooms, and printing facilities.
- Removal or modification of the pollutant source is the most effective approach to solving a known source of an indoor air quality problem, when this solution is practicable. This includes routinely maintaining the heating and air conditioning systems; replacing water-stained ceiling tiles and carpets; banning smoking or providing a separately ventilated room; venting contaminant source emissions to the outdoors; using and storing paints, solvents, pesticides, and adhesives in closed containers in well-ventilated areas; using those pollutant sources in periods of low or no occupancy; and allowing time for building materials in new or remodeled areas to off-gas pollutants before occupancy.
- Air cleaning has some limitations, but it can be a useful addition to source control and ventilation. Air filters are only effective at removing some of the pollution, not all.
- Education and communication are important parts of any air quality management program. When everyone associated with the building, from occupants to maintenance, fully understands the issues and communicates with each other they can work more effectively together to prevent and solve problems.

For More Information . . .

Call EPA's Indoor Air Quality Hotline at (800) 438-4318.

For More Information

For Information on Indoor Air Quality and Pollutants:

National Safety Council's Air Quality Program Helpline
1025 Connecticut Avenue, NW, Suite 1200
Washington, D.C. 20036
Automated Hotline: (800) SOS-RADON
Helpline: (800) 55-RADON
Fax: (202) 293-0032
E-mail: airqual@nsc.org
Web page: http://www.nsc.org/ehc.htm
Hours: Hotline - 24 hours, 7 days a week
Helpline: 8:30 a.m.-5:00 p.m. (EST) M-F (message can be left at any time)

National Lead Information Center
Optimus
8601 Georgia Avenue, Suite 503
Silver Spring, MD 20910
Automated Hotline: (800) LEAD-FYI
Clearinghouse: (800) 424-LEAD
Fax: (301) 585-7976
E-mail: lead@optimuscorp.com
Hours: Hotline - 24 hours, 7 days a week
Helpline: 8:30 a.m.-5:00 p.m. (EST) M-F (message can be left at any time)

National Center for Environmental Publications and Information (NCEPI)
PO Box 42419
Cincinnati, Ohio 45242
Phone: (800) 490-9198
Fax: (513) 489-8692or 8695
Web page: http://www.epa.gov/ncepihom/index.html

Indoor Air Quality Information Clearinghouse (IAQ Info)
P.O. Box 37133
Washington, D.C. 20013-7133
Phone: (800) 438-4318, (703) 356-4021
Fax: (202) 484-1510
E-mail: iaqinfo@aol.com
Web page: http://www.epa.gov/iaq
Hours: 9:00 a.m.-5:00 p.m. (EST) Monday - Friday

National Pesticide Telecommunication Network
NPTC OSU
333 Weniger Hall
Corvallis, Oregon 97331
Phone: (800) 858-PEST
E-mail: nptn@ace.orst.edu
Web page: http://ace.orst.edu/info/nptn

For Art and Craft Materials That Are Non-Toxic

To order a list of products that have been certified non-toxic or a book on *What You Need to Know About the Safety of Art and Craft Materials* at no cost contact:
Art and Creative Materials Institute
100 Boylston Street, Suite 1050
Boston, MA 02116
Phone: (617) 426-6400
Fax: (617) 426-6639
E-mail: acmi@guildassoc.com
Web page: http://www.creative-industries.com/acmi

For Guidance on Safe School Science Laboratories

School Science Laboratories: A Guide To Some Hazardous Substances, 1984
Council of State Science Supervisors and U.S. CPSC
U.S. CPSC (800) 638-2772, (800) 492-8104 in Maryland

Manual of Safety & Health Hazards In The School Science Laboratory, 1980
NIOSH/U.S. Department of Health & Human Services
National Technical Information Service
(703) 487-4650